

Current Science

Vol. XXIII]

JUNE 1954

[No. 6

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OPTICS OF THE PEARL

THE pearl stands in a class by itself as a gem-stone which does not need the services of a lapidary to enhance its natural beauty. The characteristic of the pearl most admired is its lustre, though other features such as shape, size and colour are also important. A precise understanding of the optics behind its loveliness is therefore a matter of more than ordinary interest. The inadequacy of the explanations of it given in the text-books on gem-mology becomes apparent on a critical examination.

Natural pearls are very expensive, and this is sufficient to discourage anyone who might feel inclined to investigate their structure and optical behaviour. Fortunately, however, the cultured pearls produced by the Japanese industry offer to the student a wealth of material of excellent quality at a modest price. As is well known, their production is the result of an operation by which a spherical pellet of calcareous substance is introduced into the body of the pearl oyster. In the course of years, the

mollusc deposits a great many layers of pearly substance around the nucleus thus provided. Since the latter is a polished sphere, the deposited layers are also very regular and smooth. Indeed, it is the case that cultured pearls are optically superior to the more expensive natural pearls. By cutting a cultured pearl into halves, the nucleus can be taken out and the hemispherical shells of pearly material thus detached are in a very suitable form for physical examination. Many interesting observations can be made with them as has been described in a recent paper¹ by the present authors.

Very simple methods of observation suffice to reveal some highly significant facts regarding the optical behaviour of pearls. A small aperture backed by a brilliant source of light is placed a few feet above the head of the observer and the pearl is held in the path of the strong beam of light thus provided. It is then viewed by the observer through a hand magnifier. The optical effects then observed fall roughly into three groups, viz., (a) the

reflection-diffraction spectra consisting of focused images of the light source, (b) a chromatic diffusion halo surrounding these images and extending over the surface of the pearl over a considerable area, and (c) a general diffusion visible right up to the periphery of the pearl. We shall proceed to describe each of these phenomena in detail and discuss their origin and significance.

If, as is the case with perfect pearls, the layers of nacreous material are parallel to the external surface, they would conspire to give a single reflected image of the source exhibiting colour as a result of interference between the effects of the successive layers. If, on the other hand, the layers meet the surface obliquely, the latter would present the aspect of an echelon grating. It has been shown by us² that in the case of mother-of-pearl the light diffracted at the surface as also that reflected by the internal stratifications appear together as a set of diffraction spectra forming a regular sequence. In the present case as well, similar results are noticed when the illuminated pearl is viewed in focus through a magnifier. The separation of the successive orders of spectra is usually very small, but occasionally they can be seen distinctly separated. Fig. 1 is a

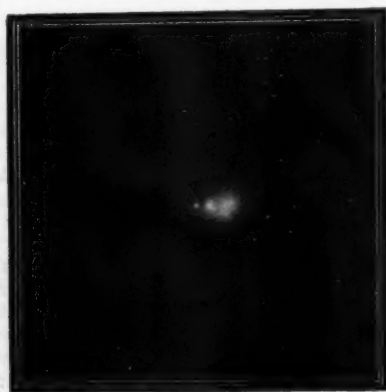


FIG. 1

photograph obtained with a natural pearl in a particular setting. Three spots in a line can be seen; the sharpest appearing at the centre is the spectrum of zero order; the second is the diffraction spectrum of the first order, while the third spot is the characteristic iridescence appearing as the spectrum of the second order.

We now proceed to consider the second of the effects mentioned above, viz., the chromatic diffusion halo. This phenomenon which does

not appear to have been noticed earlier has been briefly described by us.¹ It is characteristic of pearls and plays a fundamental role in their optical behaviour. Its observable features are notably influenced by the shape of the pearl, by the inclinations of the stratifications to the external surface and by the degree of optical perfection of the latter. The chromatic halo takes its simplest form in the ideal case of a spherical pearl in which the stratifications are strictly parallel to the external surface. It then appears as a diffuse circle of light with fainter outlying regions surrounding the iridescent reflection; there is a concentration of intensity in the halo near the opposite ends of one diameter. The predominant colour of the halo is complementary to the colour of the iridescence. A photograph of the halo in this typical case is reproduced as Fig. 2. A slight



FIG. 2

asymmetry of the intensity on the two sides is usually noticed, and this is very prominent when the successive orders of the reflection-diffraction spectra are widely separated. The colour of the diffusion halo may then be quite different on the two sides of it.

The observed effects indicate that the diffusion halo has its origin in the internal stratifications of the pearl and not at its external surface; this is indeed clear from the fact that its colour is complementary to that of the iridescence. The origin of the halo is to be sought for in the fact that the material of the pearl consists of individual crystallites of aragonite imbedded in a network of concholin. Each crystallite would diffract the light waves incident upon it in various directions, the iridescence appearing in the direction in which the diffracted radiations from the crystallites in any given layer are in agreement of phase. In other directions, they would give rise to a cone of diffuse light.

Fig. 3 illustrates a remarkable effect exhibited by pearls. It is a photograph of a natural pearl illuminated centrally over a very narrow region on the side opposite to that from which it was observed and photographed. It will be noticed that the entire pearl is thereby ren-

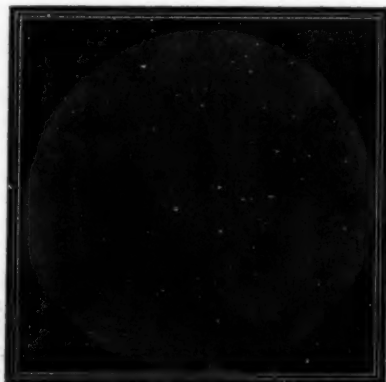


FIG. 3

dered visible, the periphery appearing brighter than the central region. It is evident that the light falling normally on the rear surface of the pearl has travelled around following the laminations of its structure, and not through the pearl. A similar effect is observed in all cases, irrespective of the direction in which the illuminating pencil falls on the pearl or the particular area on which the incident light falls.

We shall now turn to the role which the three effects described above respectively play in the optical behaviour of pearls. Fig. 4 (a), (b) and

pearl, and (c) a polished spherical segment of mother-of-pearl removed from a cultured pearl. All the three objects were illuminated and viewed in the same fashion, viz., normal to their respective surfaces, the original source of light being of small angular dimensions. But the appearance of the three objects is totally different. In the case of the steel sphere, we see a well-defined optical image of the original source, but the sphere remains invisible except in the immediate neighbourhood of the image of the source where a faint illumination is visible due to the imperfect polish of the surface. In the case of the mother-of-pearl as well, the optical image of the source is a prominent feature, but is much feebler than in the case of the steel sphere. On the other hand, the mother-of-pearl is itself visible by reason of the light diffused in the material.

Writers on gemmology usually attribute the beauty of the pearl to two distinct effects, viz., the reflection of light from the interior of the pearl and the diffraction of light at its exterior surface. The latter effect would be non-existent in the case of a perfect pearl. Moreover, the angular separation of the various orders of the reflection-diffraction spectrum is so small, that with an extended source of light they need not at all be considered as distinct phenomena. Further, the reflection of light at a spherical surface would not suffice to make it visible, much less to make it an attractive object. It is evident therefore we have to look elsewhere for an explanation of the beauty of the pearl. This is to be found in the superposition of the reflected light and the chromatic diffusion halo. Such superposition would necessarily occur when the source of light is of extended area,

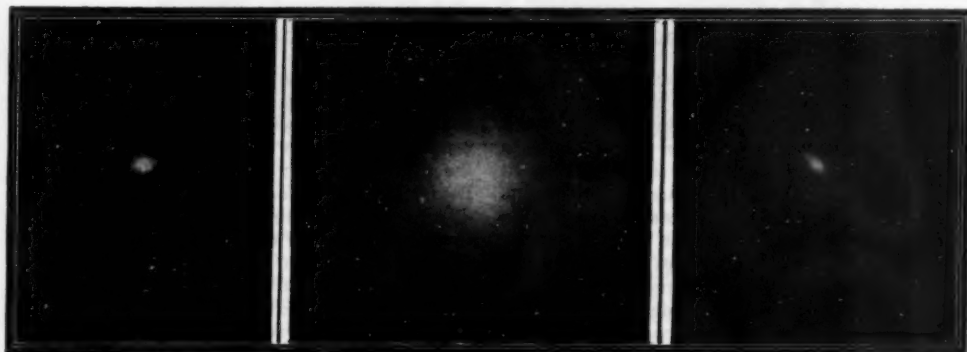


FIG. 4
(a) reproduce photographs showing respectively (a) a polished steel sphere, (b) a cultured

and since their colours are complementary, their joint effect would be to make the pearl

seem to the observer to be a silvery white and lustrous object, quite unlike a polished sphere which only exhibits the reflected images of external objects. The impression that the pearl is a lustrous object would be further enhanced by the diffuse light emerging from the shadowed areas on which no light is directly incident. The brilliance of the periphery would further enhance the general effect by enabling the entire pearl to be clearly seen.

We may sum up the situation by the statement that the coloured reflection of light by the stratifications of the nacre is not by itself

an adequate explanation of the beauty of the pearl; the special properties of the material which manifest themselves in the chromatic diffusion halo and in the propagation of light parallel to the stratifications play the leading role in making the pearl appear a lustrous and attractive object.

C. V. RAMAN.

D. KRISHNAMURTI.

1. Raman, C. V. and Krishnamurti, D., *Proc. Ind. Acad. Sci.*, 1954, **39A**, 215.
2. —, *Ibid.*, 1954, **39A**, 1.

RADIO-THULIUM TO REPLACE X-RAYS

DEVELOPMENT of a portable X-ray unit using radioactive thulium in place of electricity was announced recently by the Argonne National Laboratory of the United States Atomic Energy Commission. Weighing less than 10 lb., the unit produces rays comparable to a 100,000-volt X-ray machine without the need of a power source. Its light weight makes it possible for a doctor to carry it to isolated areas where electricity is not available and to take X-rays of persons who cannot be moved.

The active component of the instrument is a tiny particle of thulium which has been made radioactive in the heavy water nuclear reactor at Argonne. Thulium is an extremely rare material which heretofore has found little practical application.

The instrument does not require an electrical power supply as does conventional X-ray equipment. In addition, it is quite inexpensive. Exclusive of irradiation charges, the total cost of the first model was \$40. The use of thulium as an X-ray source was first suggested by British scientists who have developed a similar but less powerful instrument. Excellent rare earth separation facilities and powerful reactors in the U.S.A. permitted development of the Argonne instrument, which contains a thulium source several hundred times more powerful than the British units. Industrially also, it has potential use as a density determination device. It may find considerable use in the determination of levels and densities of liquids in closed systems.

REORGANISATION SCHEME OF THE BOTANICAL SURVEY OF INDIA

THE main features of the reorganisation scheme are as follows: (1) The division of India into a number of regional circles based on phyto-geographic affinities, each under a Regional Botanist with his headquarters at Dehra Dun or Lucknow, Madras, Calcutta and Poona respectively; (2) Establishment of a Central Directorate under the Chief Botanist, for co-ordinating the activities of the various Regional Circles; (3) The creation of a Central Botanical Laboratory under a Director at a suitable place in India, where the living plant will be studied in relation to its botany and its

utility to the nation; (4) The maintenance of a Central National Herbarium which will house the "type specimens" and a fully representative collection of the plants comprising the Flora of India; and (5) Maintenance of a Botanical Museum on modern lines at Calcutta. Collaboration with Universities and Research Institutions will be encouraged by the granting of stipends to staff and research students to conduct research on problems dealing with the Flora of India, and for collecting material for the long overdue revision of Hooker's "Flora of India".

SOLENOPORACEÆ FROM THE CRETACEOUS ROCKS OF SOUTH INDIA

L. RAMA RAO AND S. SAMBE GOWDA

THE occurrence of Solenoporaceæ in the Cretaceous rocks of South India was first recorded in 1936 in the Memoir on the fossil algæ from the Niniyur group (Danian) of the Trichinopoly Cretaceous area.¹ The algal flora in these beds is mainly composed of the Dasycladaceæ and the Corallinaceæ; but along with these, there is also the solitary occurrence of the genus *Parachætetes* belonging to the Solenoporaceæ. This form has been described and its affinities discussed in the memoir, and it is shown that it represents a new species, named *P. asvapatii*. Some years later, S. R. N. Rao² found the remains of Solenoporaceæ in the Cullygoody limestone, a formation also belonging to the Cretaceous series, but older than the Niniyur beds. He recognised in this limestone two species of Solenopora—*S. jurassica* and *S. coromandelensis*—and on the basis of these fossils, especially the former, he put forward the view that the Cullygoody limestone must be considered as Jurassic in age, and not Cretaceous as is now generally believed.

standing interest and significance. Both of them relate to the presence of Solenoporaceæ; and the following is a brief account of these two occurrences.

1. No. A3/13. (from the cherts belonging to the Niniyur group—Danian).

The general form of this alga is shown in Fig. 1. The thallus is broad and fan-like; the cell rows showing a typical 'fountain'-like arrangement are well seen in Fig. 2. The longitudinal cell walls are prominent, but of variable thickness (4-12 μ); they are wavy and sinuous with the result that the width of the cells becomes variable (32-55 μ) even along a single row. The transverse partitions are irregularly placed without any 'alignment' so that the lengths of the cells also vary from place to place (27-175 μ); these are concave towards the periphery, and the cell rows show a 'jointed' appearance in the region of these partitions. An interesting feature (seen under high magnification) is that the cell walls and the transverse partitions are both distinctly

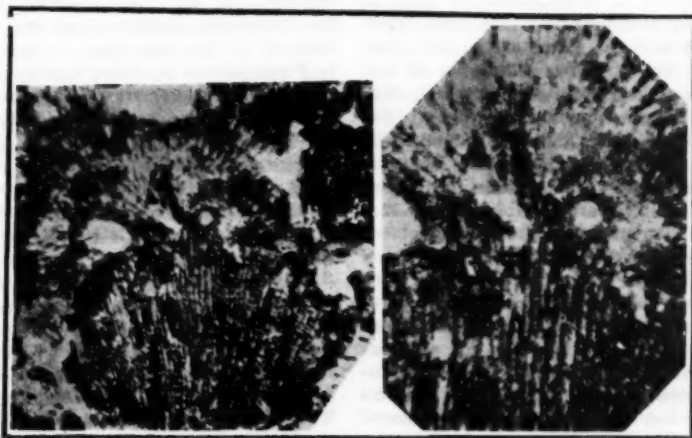


FIG. 1. $\times 24$

FIG. 2. $\times 40$

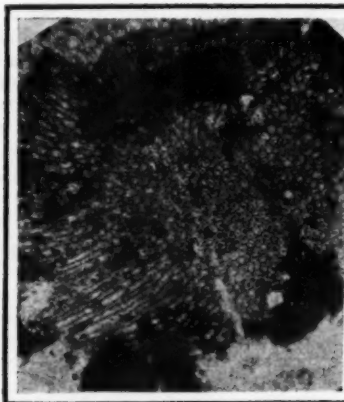
We have now taken up the study of the fossil algæ in the entire Trichinopoly Cretaceous succession* and in the course of this work we have noticed the presence of numerous algæ, including the Solenoporaceæ. While it will take some time before a full description of this algal flora is ready for publication, there are two occurrences noticed in this area which call for immediate announcement in view of their out-

* The Cretaceous of the Trichinopoly Dt., S. India, is divided into 4 groups. Starting from the oldest, these are (i) the Utatur, (ii) the Trichinopoly, (iii) the Ariyalur, and (iv) the Niniyur. The entire succession ranges in age from the Cenomanian to the Danian of the European stratigraphical scale. A full description of these rocks is given by one of the present authors (L. R. Rao) elsewhere. (*Lucknow University Studies*, No. 17, 1942, pp. 1-74).

double-layered. There are no pores in the cell walls; and there is no differentiation of the tissue into a hypothallium and perithallium.

2. No. E.72 (from the coral reef limestone near Cullapaudy, belonging to the Utatur group—Cenomanian).

been remarked by Pia, "the division of this family into different genera, and the systematic position of the whole group are still matters of controversy". The only three valid stems now recognised in this family are *Solenopora*, *Parachætetes* and *Petrophyton*. From a study

FIG. 3. $\times 40$ FIG. 4. $\times 40$

The photo (Fig. 3) gives a good idea of this form; the section is longitudinal for part of the thallus and transverse for the other part, so that we get both the views of the form side by side. The thallus shows a number of cell rows which are generally straight, and sub-parallel; they show a tendency to diverge, but not quite 'fountain'-like. The longitudinal walls are somewhat sinuous and wavy; the width of the cells becomes therefore variable from place to place, the actual variation being from 23–32 μ . The transverse partitions are irregularly placed so that the lengths of the cells are also highly variable (50–180 μ); these partitions are concave towards the periphery. There are no pores in the cell walls, either longitudinal or transverse. There is a feeble tendency for a dichotomous branching of some of the cell rows towards the periphery, but the branches are still 'apposed' and not diverging. The transverse section shows the polygonal to sub-circular outlines of the cells; but the cell cavity (lumen) is circular. Some of the cell outlines enclose a 'double-lumen' in contact, due to the branched cell row. There is no indication of the differentiation of the tissue into hypothallium and perithallium.

Important contributions to our knowledge of the family Solenoporaceae have been recently made by Garwood, Pia, Yabe, Pfender, Peterhans, Harlan Johnson and others; but as has

of the two forms described above with special reference to cell measurements, disposition of the transverse partitions, and the nature of the tissue it is clear that they do not belong either to *Parachætetes* or *Petrophyton*; they evidently belong to the genus *Solenopora*. Both our forms have been compared in detail with the two species of *Solenopora* (*S. jurassica* and *S. coromandelensis*) already described by S. R. N. Rao from the Cullygoody limestone. While both the present forms resemble *S. jurassica* in the large variation of the cell lengths, they are quite different in this respect from *S. coromandelensis*; when next we take into consideration the other characters including the widths of the cells and their proportion to the thickness of the cell walls, it is seen that the two forms now under study are both different from the species *jurassica* and *coromandelensis*. The present forms are therefore recognised as constituting two new species; it is proposed to call the former (seen in No. A3/13, Fig. 1) *Solenopora tiruchiensis* (after the District where the Cretaceous rocks of South India are typically developed), and the latter (seen in No. E72, Fig. 3) as *Solenopora sahnii* (after the late Prof. Birbal Sahnii, the distinguished Indian palaeobotanist).

The most remarkable feature of the occurrence of these Solenoporaceae here is the fact that the very rock section (E72) which con-

tains *S. sahnii* also contains a fine section of the Corallinaceæ (Melobesiæ) belonging to the genus *Archæolithothamnium* (vide Fig. 4). The section shows clearly the nature and arrangement of the cells both in the hypothallium and perithallium; the erect ovoid sporangia (height about twice the breadth) are also well seen. From the cell measurements and other characters, this form appears to be identical with (or closely allied to) *A. lugeoni* described from the Niniyur beds in the 1936 Memoir.

This occurrence of a *Solenopora* and an *Archæolithothamnium* in the same rock of undoubted Cretaceous age is of the greatest interest. Our present studies of the fossil algæ in the Trichinopoly Cretaceous area show that the coral reef limestones (Cenomanian) which show the *Solenopora* also contain plenty of Coralline algæ; the Niniyur beds (Danian) which contain abundant Coralline algæ also show the

Solenopora. These occurrences of the *Solenopora* and the Corallinaceæ together, (and both of them truly *in situ* in nature) in the same rocks of undoubted Cretaceous age are evidently of special significance since they show that the current view that the Coralline algæ made their appearance (in the Cretaceous) only after the *Solenopora* became extinct (in the Jurassic) is no longer tenable. Further investigations of these algal floras in the Trichinopoly Cretaceous, now under progress, will no doubt confirm this position and provide the most valuable material for the study of the mutual chronological and evolutionary inter-relationships of these two important families of fossil algæ.

1. Rama Rao, L. and Julius Pia, *Mem. Geo. Sur. Ind. Pal. Ind.*, 1936, 21, 4.
2. Rao, S. R. N., *Jour. Ind. Bot. Soc.*, M. O. P. Iyengar Commemoration Volume, 1946.

SCIENCE IN ANCIENT INDIA

ACCORDING to an article by M. Jean Filliozat, Professor of the College of France, published in the *Journal of World History*, research in ancient India led very early to the development of theories which, although ahead of their time, were nevertheless logical systems of thought about the structure of reality, that is to say, of science. He deals chiefly with astronomy and physiology discussed in the oldest Indian texts between 1500 and 500 B.C.

The most important astronomical work revealed in the Vedic texts is the list of 27 or 28 constellations marking the path of the moon. This sort of lunar zodiac evidently contributed to Brahmin religious rites, which were based upon the position of stars; it permitted simultaneous determination of the position of the full moon and the sun in relation to the stars. Such astronomical knowledge was widely diffused in other countries. Later, when India became acquainted with Grecian astronomy, through cultural and commercial exchanges with the Roman Empire, these earlier methods were combined with the new ones dividing the zodiac into 12 "houses", the most widely used mechanism for astrological divination.

Two other discoveries in the field of astronomy were noteworthy, that of the trigonometric sine and of the "cosmic cycle". The former of these is described in a treatise dating from the middle of the 4th century B.C. The

Arabic astronomer, al Battani, who introduced it to the West, gave full credit to its Indian origin. This was the basis for the development of trigonometry.

Calculation of the cosmic cycles of the universe were related to speculations in Greece and Western Asia about the "Great Year"—the period required for the stars to return to exactly the same apparent position which they occupied at the beginning of the interval. There is a close resemblance between the Grecian and Babylonian computations and those made in India much earlier.

In the fields of physiology and medicine, conceptions current in India between 1500 and 1000 B.C. are encountered later in Hellenic and Mesopotamian records. Some of these had an important place in the medical theories of Hippocrates.

Considering that it was India which first adopted the system of numbers, probably of Mesopotamian origin, which is the basis for our arithmetic, and spread it throughout the world, one is disposed to agree with Professor Filliozat that ancient India was indeed an energetic and influential source of scientific thought. It seems also reasonable enough to claim that she spread it throughout a region far greater than that reached by Greek science, which she generously welcomed and also diffused, along with her own teaching.—UNESCO.

AMPHIBOLES ASSOCIATED WITH THE MANGANESE-BEARING ROCKS OF MADHYA PRADESH

SRIPADRAO KILPADY AND A. S. DAVE

University Department of Geology, Nagpur

AMPHIBOLES associated with the Gondite series (Archæan Manganese-Silicate rocks) of India were first reported and described by Dr. Fermor¹ from Kajlidongri in Jhabua District of Central India and from the Balaghat, Bhandara, Chhindwara and Nagpur Districts in M.P. He remarks that these amphiboles occur very sparingly in the rocks except at Kajlidongri and divides them into two groups (a) yellow and greenish grey amphiboles referred to Danne-morite (?), and (b) the blue lilac-lavender amphiboles called Winchite and Juddite. The Dannemorite type of amphiboles and Juddite were reported mostly from M.P. while the only locality for Winchite was Kajlidongri in C.I. With the exception of Winchite the other amphiboles were not completely investigated.

In the course of a thorough re-examination and re-investigation of the non-opaque manganese minerals associated with the rocks of the Sausar series of M.P. undertaken by the authors it was found that amphiboles similar to Winchite were present in the rocks associated with the manganese ore deposits in the Ponia area of Balaghat District, M.P. This discovery of Winchite in the rocks of Madhya Pradesh is of considerable interest as hitherto this amphibole was reported only from the Kajlidongri area of Central India. Of greater interest, however, is the association with the Winchite of two other amphiboles obviously related to it but differing in their physical and optical characters. Big idiomorphic crystals of the manganese pyroxene Blanfordite, are also found associated with these amphiboles. A thorough physical, optical and chemical investigation of these amphiboles has been undertaken and this note records certain interesting preliminary observations.

OCCURRENCE

The Winchite and the two other associated amphiboles occur in a pegmatite vein which has the same general strike as the country rocks—which are quartz schists with lenticles of manganese ore. These amphiboles occur as disseminated acicular to bladed crystals and sheaf-like aggregates in the pegmatite. The pegmatite at the contacts with the quartz schist has a fine grain size and only a small amount of felspar and shows the sporadic development of small grains of a light red amphibole. With

the increase in grain size of the pegmatite away from the contacts, coarser aggregates of the light red amphibole are noticed. In the central portions of the pegmatite the amphibole present is of a deep red variety associated with idiomorphic crystals of Blanfordite. Abundant radiating aggregates of Winchite and scales and plates of Mangano-phylite are developed at the contact of the pegmatite with the manganese ore body. In this region there is a marked increase in the size and abundance of the idiomorphic crystals of the manganese pyroxene—Blanfordite. It may be mentioned here that the occurrence of Winchite from the Kajlidongri area described by Dr. Fermor¹ is in schists and quartzites, and not in a pegmatite.

Winchite (cf. *Richterite*)².—Occurs as slender elongated prisms and in radiating aggregates. Prismatic cleavage and parting across the length. Specific gravity: 2.95. Deep to light bluish violet in colour and vitreous lustre. Hardness: about 6.

Optical characters.—Strongly marked pleochroism with X = rose pink, Y = light pinkish, Z = blue; absorption: $X > Z > Y$; biaxial negative; axial plane normal to (010); extinction angle in some crystals (var. B) is $X \wedge C = 19-30^\circ$ and the elongation is negative, in others (var. A) the angle $Z \wedge C = 30-38^\circ$ and the elongation is positive. This variation in optical orientation and sign of the crystals in one and the same section was noticed by Dr. Fermor¹ in the Kajlidongri Winchite and these were designated by him as basic (var. B) and acid (var. A) varieties. Axial angle large; refractive indices: $n = 1.61-1.62$; $\gamma = 1.62-1.63$; birefringence: .020 (B) and .013 (A); MnO % in the Winchite is 1.18.

Deep Red Amphibole: cf. *Eckermannite*, var. *Imerinite*)².

Occurs as disseminated small grains and sometimes in elongated prismatic aggregates upto 3" in length. Prismatic cleavage. Specific gravity 3.24 (of prismatic aggregates). Hardness about 6. Deep brownish red in colour and vitreous lustre.

Optical characters.—Distinct pleochroism with X = pink, Y = light red, Z = brownish red; absorption: $X > Z > Y$; biaxial negative; axial plane normal to (010), negative elonga-

tion with $X \wedge C = 28^\circ$; refractive indices: $a =$ slightly more than 1.66, $\gamma =$ between 1.68-1.69; birefringence: .024 to .026; axial angle large; MnO % 4.38.

Light Red Amphibole: (cf. Anophorite).²

Occurs as disseminated small grains and sometimes as small slender prisms less than a centimetre in length; prismatic cleavage at $58^\circ 30'$; rose red in colour and vitreous lustre.

Optical Characters.—Distinct pleochroism with X = rose pink; Y = light pink; Z = colourless to pale; absorption; $X > Y > Z$; biaxial negative; negative elongation with $X \wedge C = 18^\circ$; optic axial plane normal to (010); optic axial angle large; refractive indices: $a = 1.65-1.66$; $\gamma = 1.67-1.68$; birefringence: .011-.013; MnO % = 0.995.

DISCUSSION

The Winchite from M.P. described in this paper agrees with that of the Kajlidongri specimen described by Dr. Fermor¹ in all essential physical and optical characters. Our specimen has a slightly higher MnO content, viz., 1.18%, as against 0.77% in the Kajlidongri specimen. The variation in the optic orientation and sign in the two varieties (acid and basic of Dr. Fermor) may be reasonably explained by the comparatively low double refraction on account of which "only small differences in the chemical composition may bring about a change in the mutual size of the chief indices".² The affini-

ties of Winchite with Richterite were noticed by Dr. Fermor.¹ A critical comparative study of the optical and chemical characters of the Winchites of Ponia and Kajlidongri with that of Richterite from Långban² clearly indicates the very close similarity between the minerals. The deep red and light red amphiboles closely associated with the Winchite may be considered as varieties on account of their distinct physical and optical characters. It is also seen that the deep red variety approaches Eckermannite (var. Imerinite)² in essential characters and the light red amphibole is near Anophorite indicating clearly that these two amphiboles are in all probability intermediate members of the Eckermannite-Arfvedsonite series.

In conclusion it may be said that in the Ponia pegmatite there occurs an isomorphous series of manganese amphiboles lying in between Richterite at one end and Arfvedsonite at the other. A detailed optical and chemical study of these amphiboles and their paragenesis will be published in due course. A re-investigation of the Blanfordite associated with these amphiboles is also being completed and will form the subject-matter of another paper.

1. Fermor, L. L., *Mem. Geol. Surv. Ind.*, 1909, **37**, I, 145-160, 150, 151-158, 158.

2. Sundius, N., *Sver. Geol. Und. Arsb.* 1946, **60**, No. 4, 7-9, 9-10, 14, 14, 8, 9-10.

VITAMIN-C REQUIREMENTS

IN an attempt to determine the minimum vitamin C requirements of man, the British Medical Research Council organized, through the Accessory Food Factors Committee, a clinical trial on human volunteers. The investigation was carried through at the Sorby Research Institute, Sheffield, between 1944 and 1946 under the direction of Professor H. A. Krebs, one of last year's Nobel Laureates in Medicine. The full report, which has recently been published (*Special Report Series*, Medical Research Council, London, 1953, No. 280) is a monumental work extending almost to 200 pages. The report concludes that the minimum protective dose, measured by the presence or absence of the signs of scurvy, is in the region of 10 mg. daily. Further, in order to arrive at a figure for a daily allowance which covers individual variations and includes a safety margin, it is

suggested that the minimum protective dose of 10 mg. be trebled. An allowance of 30 mg. daily is in accordance with the recommendation by the League of Nations Health Organization Technical Commission on Nutrition made in 1938.

This dose is much less than 75 mg. per day which had previously been recommended by the U. S. National Research Council. Commenting on this, the *British Medical Journal* (April 3, 1954) observes that no one has yet succeeded in demonstrating the slightest traces of ill-effect with intakes of that order or even appreciably below it. It cannot be entirely ruled out as a possibility that a higher intake may be advantageous in order to provide a presumed "optimum" as distinct from a mere "adequacy", but this has not yet been conclusively proved.

CYTOLOGY OF SEMISTERILE RICE HYBRIDS

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Central Rice Research Institute, Cuttack

SINCE 1950 a scheme for breeding high-yielding types of rice, by hybridizing Japanese or *japonica* varieties of rice with tropical or *indica* varieties of rice is being conducted at the Central Rice Research Institute, Cuttack. In these inter-racial crosses, varying degrees of sterility occurs in the F_1 and in many of the subsequent progenies. The occurrence of semi-sterility in such crosses is well known and it is also known that the environmental conditions affect the extent of sterility. In addition to the environment, it is probable that genic, chromosomal, and cytoplasmic factors control the extent of sterility. An interpretation of rice hybrid semi-sterility on basis of three pairs of genes has been attempted by Kuan Jen Hsu.² The evidence for the part played by chromosomal and cytoplasmic factors is presented.

For chromosomal study PMC division was examined from acetocarmine mounts and paraffin sections. Eighty-five hybrid combinations showing 25-99 per cent. spikelet sterility were studied, out of a large number of hybrids produced by crossing eight improved types of rice from Japan with about 50 types of rice from India, Burma, Ceylon, Malaya, Pakistan, Thailand, Indonesia, Indo-China and Philippines. In all these hybrids, chromosome pairing was found to be normal in the MI stage, twelve bivalents being formed. However, in all the cells two or three pairs of chromosomes showed loose pairing having not more than one terminal chiasma each. Even in diplotene, one or two bivalents had a single terminal chiasma. These pairs can be pressed apart in smearing and also were observed as univalents in some cells (Fig. 1). In the first anaphase of this



FIG. 1. MI, F_1 Taichu 65 \times Adt. 12, acetocarmine mount bivalents pressed apart, $\times 2,750$.

division, abnormalities were present in some of the cells of most of the hybrids. These abnormalities are classifiable as presence of lag-

gards, stretched chromosomes, and anaphase bridges with fragments (Fig. 2). Total num-



FIG. 2. AI, F Norin 20 \times Khabu das, anaphase bridge with fragment, $\times 2,750$.

ber of cells in AI stage observed were 5596. In 33 hybrid combinations irregularities were found in more than 10 per cent. of cells observed, and anaphase bridge with fragment was found in eleven combinations.

As a result of this detailed study, it is possible to make the following inferences: The occurrence of anaphase bridges must be due to presence of inversions in some chromosomes. Rice cultivation was introduced into Japan from the mainland and the *japonica* types were evolved under Japanese agricultural conditions. Under these conditions structural changes in chromosomes including inversion of segments have been selected and preserved in a homozygous condition. On crossing with *indica* types, crossing over between inverted and corresponding normal segment would tend to cause formation of anaphase bridges.

The presence of cryptic structural differences between chromosomes of different races of rice has been conjectured by Japanese workers and the previous work discussed by Cua.¹ The present work gives evidence for presence of one type of structural change, viz., inversion. The study is being continued for detecting other types of changes. It is evident that the F_2 and later progenies may carry chromosomal changes like deletion and duplication. How far the new chromosome combinations are viable is unknown.

It is not suggested that Japanese rice varieties alone have undergone chromosomal changes, or that all the varieties have undergone the

same type of change. The anaphase bridges recorded by Mello Sampayo³ in hybrids between two *japonica* types of rice brings out this complexity. The Japanese varieties are however characterised by a group of morphological and physiological characters and are normally interfertile.

The part played by cytoplasmic factor was observed recently at Central Rice Research Institute, Cuttack.⁴ This was detected by differences in extent of grain setting in reciprocal crosses. In order to find out if gametic fertility is affected by the cytoplasm, the

crosses, *Rikuu 132* (Japan) \times *Adt. 18* (Madras) and *Gimbozu* (Japan) \times *T. 1145* (Orissa) and their reciprocals were studied for pollen sterility. The data of pollen sterility as shown by iodine mounts are as follows:

The differences between reciprocal crosses when grown under identical conditions is statistically significant and therefore shows that the cytoplasm as transmitted by the female parent has an effect on pollen development in the F_1 generation.

We are indebted to Dr. N. Parthasarathy for facilities and to the FAO of the United Nations Organisation for financing the scheme.

Cross combination	Mean %	S.E.
<i>Rikuu 132</i> \times <i>Adt. 18</i>	84	1.7
<i>Adt. 18</i> \times <i>Rikuu 132</i>	69	1.6
<i>Gimbozu</i> \times <i>T. 1145</i>	50	1.3
<i>T. 1145</i> \times <i>Gimbozu</i>	28	2.6

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LADY TATA SCHOLARSHIPS AND GRANTS FOR 1954-55

THE Trustees of the Lady Tata Memorial Trust announce on the death anniversary of Lady Meherbai Dorabji Tata, 18th June 1954, the awards of Scholarships and Grants for the year 1954-55.

The International Awards of varying amounts totalling (£ 6,275) for research in diseases of the blood with special reference to Leucaemias are made to Doctors J. F. Kieler (Denmark), Astrid Fagraeus and Bo. Thorell (jointly) (Sweden), R. Rask-Nielsen (Denmark), R. Robineaux (France), J. Nordmann (France), N. A. Stenderup and F. Kissmeyer-Nielsen (on a joint research project) (Denmark), J. Ring-

sted (Denmark), J. Rygaard (Denmark), M. Seligmann (France), G. Negroni (of Italy, working in England), and Dr. A. Sreenivasan (Bombay).

Indian Scholarships of Rs. 250 per month each for one year for scientific investigations having a bearing on the alleviation of human suffering from disease are awarded to Dr. (Mrs.) M. Aikar (Gwalior), Miss K. S. Laul (Bombay), Mr. P. R. J. Gangadharam (Bangalore), Mr. N. V. Bringi (Bombay), Dr. R. S. Grewal (Lucknow), Mr. N. A. Nityananda Rao (Bangalore), and Mr. T. K. Sundaram (Madras).

SOLAR BATTERY

THE Bell Telephone Laboratories have announced the invention of an electric battery which uses sunlight as its fuel, and which develops enough power to run toys or transmit voices for short distances over wires. An efficiency of 6 per cent. is claimed for the battery in converting sunlight directly into electricity, which compares favourably with the efficiency of steam and petrol engines in contrast with other photo-electric devices, which have a rating of no more than 1 per cent.

The experimental solar battery uses strips of wafer-thin silicon about the size of a com-

mon razor blade. These strips are highly sensitive to light, and can be linked together electrically and deliver power from the sun at the rate of 50 watts per square yard of surface.

The solar battery, along with other silicon devices demonstrated at the laboratories, would seem to be an offshoot of a broad study of silicon and its possible application in modern electronics. An important feature of these silicon devices is that they can operate at much higher temperatures than other crystal rectifiers now in use.

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HYDRODYNAMICAL GENERALIZED SINGULAR POINTS

It is not generally realized that the introduction of the idea of generalized singular points simplifies problems in classical hydrodynamics to such an extent that most of the results of the linear theory can be reproduced without any effort. It is known that non-viscous flows can be produced by a suitable distribution of singular points like sources, sinks, doublets and vortices. But, except in the case of simple boundaries like a plane, a sphere or a cylinder, such distributions are infinite in character and hence are of not much practical importance. A generalization of such singular points as ultimate forms of closed surface bodies reduces

the infinite number of spherical or circular points to a single generalized point. For example, the uniform motion of an ellipsoid in a non-viscous liquid can be produced by a single ellipsoidal doublet in the same manner as that of a sphere by a spherical doublet. In all such cases the potential of the generalized source is the same as the static potential at an external point of a closed body whose ultimate form is the generalized source. For motion of rotation the generalized doublet is replaced by a generalized vortex.

For slow viscous motion the equations are linear and the corresponding solution can be obtained by superposing on the doublet a solution due to a concentrated force in an infinite

elastic body (viscous liquid). Furthermore, it is found that the concentrated force is the drag suffered by the body. For example, for a sphere of radius a moving with velocity U the irrotational doublet solution is¹:

$$u_1 = -\frac{1}{2}U \left(\frac{a}{r}\right)^3 + \frac{3}{2}U \frac{x^2}{a^2} \left(\frac{a}{r}\right)^5,$$

$$v_1 = \frac{3}{2}U \frac{xy}{a^2} \left(\frac{a}{r}\right)^5,$$

$$w_1 = \frac{3}{2}U \frac{xz}{a^2} \left(\frac{a}{r}\right)^5.$$

The solution for a concentrated force P acting at the origin along the x -axis is:

$$u_2 = \frac{P}{8\pi\mu} \left(\frac{x^2}{r^3} + \frac{1}{r}\right), \quad v_2 = \frac{P}{8\pi\mu} \frac{xy}{r^3},$$

$$w_2 = \frac{P}{8\pi\mu} \frac{xz}{r^3},$$

μ being the rigidity (viscosity). Putting $u = Au_1 + u_2$, etc., the boundary conditions immediately give $A = -\frac{1}{2}$ and the drag as $P = 6\pi\mu aU$. Similar results can be obtained for an ellipsoid. For a cylinder, as we know from the theory of elasticity, the concentrated force solution is defective at infinity where u_2 becomes infinite. But near the surface of the body it is considered quite good.

For any body whose surface in orthogonal curvilinear co-ordinates, ξ, η, ζ is given by $\xi = a$ and whose potential at an external point, V , is $x = a(\xi)$, the irrotational flow potential for motion along the x -axis is $-\partial V/\partial x$. The corresponding slow viscous flow is given by

$$u = A \frac{\partial V}{\partial x} - \frac{P}{8\pi\mu} \left[\frac{\partial}{\partial x} (x\psi) - 2\psi \right]$$

$$v = A \frac{\partial V}{\partial y} - \frac{P}{8\pi\mu} \frac{\partial}{\partial y} (x\psi),$$

$$w = A \frac{\partial V}{\partial z} - \frac{P}{8\pi\mu} \frac{\partial}{\partial z} (x\psi),$$

where ψ is the solution in the orthogonal curvilinear system, which is a function of ξ only, and where

$$A = \frac{\psi'_0}{\psi_0 a'_0 + \psi'_0 a_0}, \quad \psi'_0 = \left(\frac{\partial \psi}{\partial \xi}\right)_{\xi=a_0}.$$

The drag is given by

$$P = \frac{8\pi\mu a_0' U}{\psi_0 a_0' + \psi'_0 a_0}.$$

In the case of cylinders the factor 8π is replaced by 4π . For motion of rotation the concentrated force is replaced by a "generalized centre of rotation".

These results reduce classical hydrodynamics to the determination of only two types of statical solutions, and hence can be of great use both at the undergraduate and at the post-

graduate level of teaching. By analogy with results in the theory of elasticity they also bring out the well-known results that for linear viscous flow the velocity components should be small and that near the surface of the body Stokes's solution is a sufficiently good approximation.

Indian Inst. of Tech.,
Kharagpur, April 12, 1954.

B. R. SETH.

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INFLUENCE OF MECHANICAL PRESSURE ON BARRIER HEIGHT IN GALENA RECTIFIERS

PRECISE quantitative information regarding dependence of barrier height on the mechanical pressure with which the whisker is engaged to the crystal (rectifier) is meagre. A detailed investigation was therefore undertaken employing in the first instance Galena rectifiers with whiskers of platinum, aluminium and carbon. After selecting a proper point¹ of contact on the crystal surface, mechanical pressure was adjusted carefully. It was found from the D.C. characteristics that there exists an optimum pressure at which the degree of rectification is maximum (Fig. 1a, b). Following



FIG. 1. (a) Lower pressure. FIG. 2. (b) Optimum pressure.

Gibson,² we have determined the barrier height as a function of mechanical pressure from the current-voltage characteristics in the easy flow direction. Table I shows that the barrier height increases initially with pressure; reaches a maximum value and then decreases with a further increase in the mechanical pressure. It is interesting to note that the optimum pressure is characterised by maximum barrier height and minimum spread resistance at the point of contact. Similar results are obtained with aluminium and carbon whiskers.

TABLE I

Variation of barrier height and spread resistance with whisker pressure Galena rectifier—platinum whisker. (Radius of the whisker at the point of contact: 0.008 cm.)

Pressure (g. weight)	Barrier height ϕ (volts)	Spread resistance R_s (ohms)
30	1.275	82.10
50	1.320	26.90
70	1.698	25.40
90	1.780	22.37
110	1.830	15.61
130	0.560	53.94
150	0.320	67.55

These results suggest that the barrier height is not entirely due to the difference in the thermionic work functions^{3,4} of the crystal and the metal whisker, but is also determined partly by the proximity of the whisker. Bardeen⁵ with his postulate of large number of surface states at the crystal surface has shown that the barrier height does not depend on the nature of the metal of the whisker.⁶ The observed dependence of the barrier height on the whisker pressure indicates that the surface states are affected to a certain extent by the intimacy of the contact between the crystal and the metal whisker.

Further work with other crystal rectifiers is in progress.

Our grateful thanks are due to Dr. V. N. Thatte for his kind interest and guidance.

Dept. of Physics, J. N. DAS.
College of Science, Nagpur, V. G. BRIDE.
March 26, 1954.

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CATALYSED POLYMERISATION OF STYRENE IN TOLUENE

THE use of phenylazotriphenylmethane as a catalyst for the polymerisation of styrene was first reported by Schulz.¹ As is well known, the catalyst on heating can give rise to two transient free radicals in solution:



These free radicals can act as initiators in addition polymerisation and will thus get incorporated in the polymer molecule.²

According to Schulz,¹ upto a concentration of 3×10^{-5} mole azo compound per mole of styrene, the initiation reaction in the bulk polymerisation of styrene is monomolecular with respect to the catalyst concentration.

The use of catalysts in studying the chain-transfers of monomers with different solvents was first envisaged by Mayo.³ We have also studied the chain transfer reaction between growing styrene (M) polymer radical and toluene (S), when catalysed by different quantities of the catalyst (B), phenylazotriphenylmethane. According to Eyring *et al.*, the following equation is arrived at for a catalysed reaction in a solvent, on the basis of a bimolecular initiation:

$$\frac{1}{P} = \frac{(k_i k_t)^{1/2}}{k_p} \cdot \frac{B^{1/2}}{M^{1/2}} + \frac{k_{tr}}{k_p} + C \cdot \frac{S}{M} \quad (1)$$

If, however, the idea of a monomolecular initiation as advanced by Schulz is accepted, the equation can be written as below:

$$\frac{1}{P} = \frac{(k_i k_t)}{k_p} \cdot \frac{B}{M^{1/2}} + \frac{k_{tr}}{k_p} + C \cdot \frac{S}{M} \quad (2)$$

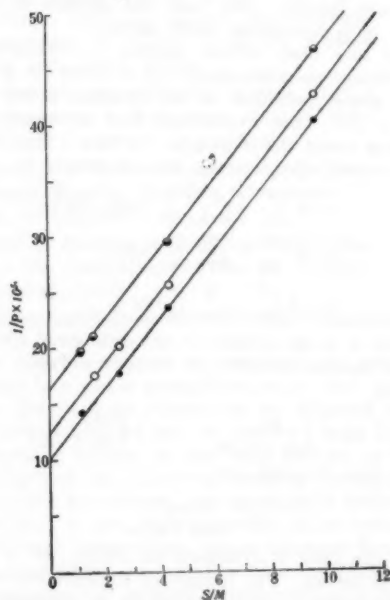


FIG. 1. Temp. 80°C.

$\sqrt{(B/M)}$ values: \bigcirc 7.941×10^{-3} ; \bigcirc 3.213×10^{-3}
($C \times 10^5$) : 3.10 ; 3.13

; \bullet nil
; 3.10

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In the above equations C is the chain-transfer constant, and is equal to k_{tr}/k_p . The other symbols have the usual significance.

In our present studies it has been shown that the transfer constant, calculated from the slope of $1/P$ against S/M plots at constant $\sqrt{B/M}$ values at 80°C . is not appreciably affected by the presence of low concentrations of the catalyst. This is graphically illustrated in Fig. 1. It would be seen that all the curves are parallel to each other, and their slope remains practically the same as in the case of the uncatalysed reaction.

A test has been made as to whether the initiation reaction is monomolecular or bimolecular. When $1/p$ is plotted against $\sqrt{B/M}$ for a series of constant S/M values the plots are found to be linear and parallel to each other. On the other hand, the plots of $1/P$ against $\sqrt{B/M}$, for a series of constant S/M values, though linear, have different slopes. This shows that equation (1) and not (2) is applicable in the present case. The evidence is thus in favour of a bimolecular initiation.

The best thanks of the authors are due to Prof. A. C. Chatterji for facilities.

Dept. of Chemistry,
Lucknow University,
Lucknow, March 16, 1954.

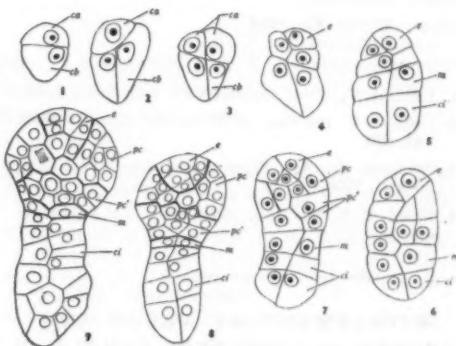
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DEVELOPMENT OF THE EMBRYO OF *COCCULUS VILLOSUS* DC

THE structure and development of the ovule and embryo sac¹ and microsporogenesis² in *Cocculus villosus* DC have already been described. Embryo development has not been studied so far. A brief description of the development of the embryo of this plant is recorded here.

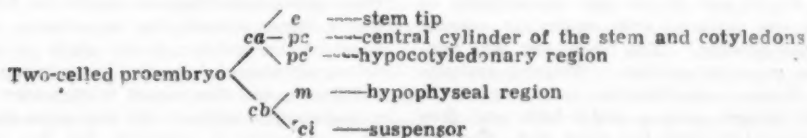
The zygote divides transversely and gives rise to two superposed cells, the apical cell ca and the basal cell cb (Fig. 1). Each of the cells of the two-celled proembryo divides by an obliquely vertical wall (Figs. 2 and 3). The two daughter cells of the basal cell undergo a transverse division resulting in the formation of two superposed tiers of cells, the upper m and the lower ci (Figs. 5 and 6). Tier m contributes to the formation of the hypophyseal region. The lower tier ci undergoes a number of transverse divisions (Figs. 6, 7, 8 and 9) and forms an elongated suspensor.



FIGS. 1-9. Various stages in the development of the embryo.

FIGS. 1-7, $\times 365$; FIGS. 8 and 9, $\times 255$.

The two juxtaposed cells derived from the apical cell undergo one oblique division each (Figs. 4 and 5) and give rise to a triangular epiphyseal initial e and three subepiphyseal cells. The epiphyseal initial divides in various planes (Figs. 7, 8 and 9) and forms the stem apex. The divisions in the subepiphyseal cells are rather irregular (Fig. 6). However, ultimately they give rise to two distinct tiers of cells: the upper pc forming the central cylinder of the stem and the lower pc' giving rise to the hypocotyledonary region (Figs. 7, 8 and 9). The following scheme summarises the derivation of the various organs of the mature embryo from the proembryonic cells:



The embryo development conforms to the Onagrad type of Johansen³ and keys out to the Trifolium variation. The embryo development of *Tiliacora racemosa* studied by the author¹ also conforms to the Trifolium variation of Onagrad type. It may be mentioned that both *Cocculus* and *Tiliacora* belong to the same tribe, Cocculeae.

The writer is indebted to Prof. J. Venkateswarlu for suggesting the problem and for his guidance.

Dept. of Botany, R. L. N. SASTRI.
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SUPPLEMENTARY VALUE OF LUCERNE AT DIFFERENT LEVELS IN THE POOR RICE DIET

In an earlier study,¹ it was shown that lucerne powder (*Medicago sativa* Linn.) is an excellent supplement to the poor South Indian rice diet when fed at 10 per cent. level. It was further shown that the beneficial effects of lucerne supplements are maintained in successive generations of rats. In this note, the results of an experiment designed to determine the optimum level of lucerne supplements in rice diet are reported.

Freshly weaned albino rats weighing 40-50 g. were distributed into seven comparable groups of six each. The animals were fed *ad libitum* on (i) the South Indian rice diet which had the same composition as that adopted by the Vanaspati Research Committee of the Ministry of Food¹ and (ii), (iii), (iv), (v), (vi) and (vii) the same diet in which rice constituting 2, 4, 7, 10, 13 and 16 per cent. respectively of the diet was replaced with equivalent amount of lucerne powder. The basal diet was prepared as described earlier. Weighed amounts of the lucerne supplements were cooked in separate beakers over a water-bath and then mixed separately with the basal diet. The re-

sults of the experiment for a period of 8 weeks are shown below:

Group No.	Lucerne powder in rice diet %	Average daily food intake (g.)	Average weekly growth of rats (g.)
I	0	7.1	4.2±0.48*
II	2	8.3	8.1±0.59
III	4	9.9	11.4±0.67
IV	7	10.8	12.3±0.86
V	10	10.5	11.4±0.62
VI	13	9.6	10.6±0.66
VII	16	10.8	11.8±0.75

* Standard error of the mean.

The critical difference for comparing the average weekly gains in weight of any two groups works out to be 1.93 g. It will be seen therefore that while there was a significant difference between the groups I & II, and II & III, there was no significant difference between any two of the groups III-VII. The rate of growth of animals receiving the rice diet was doubled on giving 2 per cent. lucerne supplement and increased threefold when 4 per cent. lucerne was given. Any further increase in the proportion of lucerne did not significantly improve the rate of growth of the animals. Therefore, lucerne is a very good supplement to the poor rice diet even at low levels, the optimum level for supplementation being 4 per cent.

Thanks are due to the Lady Tata Memorial Trust for awarding a scholarship to one of the authors (B. K. S.).

Central Food Tech. B. K. SUR.
Res. Institute, V. SUBRAHMANYAN.
Mysore, March 23, 1954.

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THE REACTION BETWEEN PYRIDINE AND METHYL IODIDE

THE formation of pyridine methiodide has been the subject of extensive investigations but in a fair proportion of the earlier work there is no clear indication whether the work has been really under homogeneous conditions. Edwards² clearly demonstrated the importance of this aspect of the problem in his study of the formation of phenyl trimethyl ammonium iodide and Davies and Cox report work under strictly homogeneous conditions for the same reaction.¹ No such work is available for the reaction

TABLE I

	Initial concentration moles/l.		Temperature ° C.	Bimolecular rate constant $k_2 \times 10^3$	Arrhenius activation energy k cal.	\log_{10} frequency factor
	pyridine	Me-I				
A. Solvent: Acetone	0.09727	0.08280	40	58.43	11.280	4.71
	0.09790	0.08549	50	111.4		
	0.08459	0.07920	60	193.5		
B. Solvent: 95% Ethyl Alcohol	0.09480	0.08563	40	8.67	17.820	8.41
	0.09893	0.08539	50	20.95		
	0.09194	0.07698	60	48.35		

under investigation. Further the influence of solvent on this reaction has not been fully elucidated.

Hinshelwood⁵ considers that the solvent functions primarily for energy transfer while Harman Stewart, and Ruben using an isotopic tracer technique report the formation of an intermediate complex in all Menschutkin reactions.⁴

Since the reaction leads to the production of ions, it may be inferred that the ionisation of the alkyl halide is a significant step and any solvent that could stabilise the ions by solvation will favour the reaction. Further, it is difficult to decide whether the reaction is an ion-dipole or a dipole-dipole reaction. Eyring and co-workers³ using the relationship between the rate constant and $(D-1)/(2D+1)$ consider that the reaction is of the dipole-dipole type. From kinetic considerations it can be shown that the reaction will be of the second order only if the reaction is initiated by the prior polarisation of the methyl iodide. Ninety-five per cent. alcohol and pure acetone have been chosen in the present study and the course of the reaction has been followed by the estimation of the iodide ions formed. The results obtained are summarised in Table I A and B.

The high activation energy noticed in alcoholic solutions as well as the lower value in acetone are quite consistent with earlier work but it will be noticed that in spite of the low frequency factor in acetone the reaction is faster in this solvent. The dominant factor is thus seen to be the activation energy of the reaction. In both cases the mechanism appears to require solvation of the activated complex in the transition state, though different pictures are necessary for the proper interpretation.

A fuller account of the experimental details and the discussion of the results will appear elsewhere.

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ANTIBIOTICS IN CALF NUTRITION

IN recent years, a number of investigations have been carried out to study the effect of adding small quantities of antibiotics in the diet on the growth and health of young calves.¹ So far, no such studies have been reported in this country. A gift of Aurofac (product of aureomycin fermentation) made by M/s. Lederle Laboratories (India), Ltd., offered us an opportunity to study its growth and health-promoting values on calves born in the Institute farm.

Calves of both sexes immediately after weaning were selected and divided into two groups—control and experimental. The grouping was so made that each animal in one group had a counterpart in the other in regard to sex and breed, and as close as possible, to initial body weight and size. The selected calves irrespective of their grouping were fed during (i) the first 30 days: whole milk adjusted to 3.7 per cent. fat, at 10.0 lb. for Sindhi and Gir and 12.5 lb. for cross-bred calves per 100 lb. body weight, (ii) the second 30 days: whole milk adjusted to 3.7 per cent. fat + skim milk

(3:1), at 7.5 lb. for Sindhi and Gir and 10.0 lb. for cross-bred per 100 lb. body weight. The calves were also induced to eat solid feeds in the form of a soaked concentrate mixture of crushed oats, groundnut cake and wheat bran (3:1:1), green lucerne and ragi straw, and (iii) the last 30 days: whole milk adjusted to 3.7 per cent. fat + skim milk (1:1), at the same rate as in (ii), and solid feeds as mentioned above in measured quantities. The animals in the experimental group received in addition a supplement of Aurolac at the rate of 10.0 g. per 2.5 lb. of dry solid consumed. According to the manufacturer, a pound of Aurolac contains not less than 1.8 mg. vitamin B₁₂ and 1.8 g. aureomycin.

The results so far obtained with 12 calves equally divided between the control and experimental groups during the 90-day observation are as follows:

(a) The calves receiving the Aurolac supplement, with initial mean body weight of 51 lb., gained 0.82 lb./calf/day whereas those in the control, with initial mean body weight of 50 lb., gained 0.48 lb./calf/day. The difference in the two growth rates was statistically examined by the analysis of variance and found significant at 5 per cent. level. (b) The improved growth rate of Aurolac-supplemented calves was also reflected in the body measurements taken initially and at the end of the observation period. The average percentage gain in height, length and girth was 17, 23 and 28 respectively for the experimental group as compared to 10, 18 and 20 respectively for the control. (c) The average per head consumption of milk per pound of gain in body weight was 10.6 lb. and 21.3 lb. for experimental and control groups respectively. (d) The calves receiving the Aurolac supplement took to non-milk solid feeds earlier and more readily than those in the control. (e) Throughout the entire period of observation, the calves receiving the Aurolac supplement showed no signs of digestive trouble. Five out of six calves in the control group, however, suffered from attacks of scour of varying degrees. (f) Aurolac supplementation in the diet had apparently no protective action against common cold, because calves in both the groups suffered from the same at one time or the other of the observation period. (g) The Aurolac fed calves showed more shine in their coat, looked more thrifty and generally appeared of better body-built than the control animals. The details of the work will be published elsewhere.

Our thanks are due to Dr. K. C. Sen for his keen interest in the progress of this work.

Indian Dairy Res. Inst.,
Bangalore,
March 8, 1954.

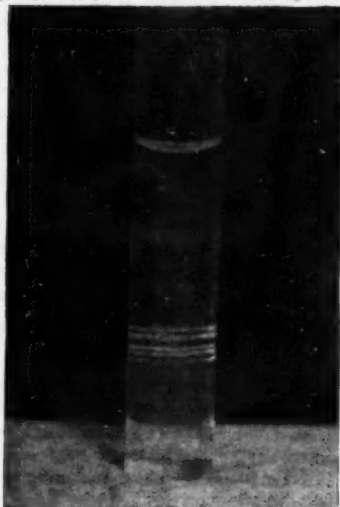
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USE OF OUDIN'S GEL DIFFUSION TECHNIQUE FOR DETERMINATION OF PURITY OF PROTEINS AND POLYSACCHARIDES

IMMUNOLOGICAL techniques are more specific and more sensitive than physical methods for assessing the homogeneity of biological samples.¹ The simplest and probably the most useful of these is that worked out recently by Oudin,² in which the antigenic material and its antisera are allowed to diffuse towards each other through an intervening layer of agar gel and the proteins or polysaccharides in the test material form sharply defined lines of precipitation when they meet their respective antibodies. A single pure substance does not give rise to more than one line, and also there is no Liesegang ring phenomenon in the system.³ The



number of lines indicate the minimum number of antigens in the substance under test and the position of a particular line depends only on the relative concentration of the antigen and its antibody.

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The technique used in our laboratories is a slight modification of Bowen's procedure.⁴ A stock solution of 1.6 per cent. filtered agar was melted and maintained at 50° C. To this was added antisera in the ratio of 0.7 ml. of antisera to 0.3 ml. of melted agar. 0.5 ml. of this mixture was poured carefully into narrow test-tubes 8-10 mm. diameter and 8-10 cm. long. When the layer had set, 1 ml. of plain filtered 0.8 per cent. merthiolated agar was poured over the first layer and allowed to set. 0.5 ml. of antigen solution was then added and the tubes were sealed and kept in incubator at 37° C. The number and intensity of the lines in the middle layer were read after 3 days, 7 days and 15 days.

The antisera were prepared by repeated subcutaneous and intravenous injections of the antigenic material into rabbits. The antisera obtained from several bleedings were pooled and preserved with 0.01 per cent. merthiolate.

Using Oudin's technique we determined the number of components and the common antigens in the venoms of the poisonous snakes of India, viz., cobra, krait, Russell's viper and *Echis carinatus*. Results are summarised in Table I.

TABLE I
Results of Oudin's gel diffusion technique
with venoms

	Cobra venom	Krait venom	Russell's viper venom	Echis venom
Cobra antisera ..	7	3	1 faint	nil
Krait antisera ..	2	7	nil	nil
Russell's viper antisera ..	1 faint	nil	8	4
Echis antisera ..	nil	nil	5	7

It is seen from the table that there are at least three common antigens between the venoms of cobra and krait both of which belong to the family *Elapidae* and there are about five common antigens between the venoms of Russell's viper and *Echis carinatus*, both of which belong to the family *Viperidae*. However, there was a faint indication of one common antigen between cobra and Russell's viper venoms. Details will be published elsewhere.

Attempts are also being made to fractionate cobra and Russell's viper venoms using Oudin's technique as a criterion of the purity of the fractions.

The purification of Diphtheria toxoid by various methods has also been followed by Oudin's technique.

The authors are grateful to Dr. P. M. Waggle and Dr. A. K. Hazra for their encouragement and for providing facilities.

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CHARACIOSIPHON FROM TIRUPATI

THE first report of this alga as a new genus of Chlorococcales was by Iyengar¹ from a shallow stream near Trichinopoly (S. India). There were no subsequent reports of this form.

Recently a note² about this genus with some interesting features appeared in *Current Science*. The interesting features were the robust size and the lobations of the thallus. Such lobing of the thallus was not described by Prof. Iyengar.

The writer collected this alga in a semi-permanent stream from Tirupati during the monsoon months (October-December) 1952. The form was found growing both on stones, floating pieces of sticks and other objects like submerged leaves even epiphytically and disappeared quite quickly with the drying up of the stream. The present form showed no such lobation; as described by Prof. Agarkar but differ in its size. The thalli of this place are longer than those described by both Iyengar and Agarkar measuring between 1.2 cm. to 1.3 cm. when full grown. But they are narrower than those described by Agarkar and slightly broader than those described by Iyengar measuring between 1.5-2 mm. when mature. A detailed account dealing with the life-history of the alga will appear elsewhere.

The writer is grateful to Prof. F. E. Fritsch and Prof. M. O. P. Iyengar for their kind help and to Dr. A. Ramakrishna Reddi for the kind facilities given.

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CHEMICAL STANDARDS FOR COFFEE
POWDER

THE analytical figures found to be most useful in testing the genuineness of coffee powder or estimating the amount of foreign adulterants in it, after detecting them microscopically, are: (1) water extract, (2) alkalinity of ash, (3) caffeine, and (4) fat content. Analysis of a large number of genuine and adulterated coffee powder samples received in this laboratory under the Madras Prevention of Adulteration Act during the last two decades showed that the water extract varied from 26 to 32 per cent.; alkalinity of ash (number of ml. of $N/10$ HCl required to neutralise the alkalinity of ash from 5 g. of coffee powder) from 18 to 24; fat from 10-15 per cent. and caffeine from 1.2-2.3 per cent.; but samples with caffeine content exceeding 2 per cent. were few. These figures generally agree with those published in textbooks but the average caffeine content¹ given in some books is only 1.2 per cent., the maximum being 1.8 per cent.

With a view to fixing chemical standards for coffee powder, seeds of *C. arabica* and *C. robusta*, which are the important varieties grown in South India, were obtained from reliable sources, roasted and powdered for the experiments. The analytical figures of a few samples of each variety are given in the following table.

Analytical figures for *C. robusta* and
C. arabica

Variety of coffee	Serial number	Water extract	Alkalinity of ash	Caffeine %	Fat (petrol extract) %
<i>C. robusta</i>	.. 1	30.2	21.7	2.40	8.4
do	.. 2	29.4	23.0	2.30	7.6
do	.. 3	29.8	21.0	2.20	9.0
do	.. 4	29.2	20.3	2.22	7.2
do	.. 5	30.0	21.5	2.35	7.8
do	.. 6	29.0	22.0	2.03	8.0
<i>C. arabica</i>					
Plantation A	.. 7	30.0	19.2	1.30	15.7
do	.. 8	29.2	21.6	1.30	12.5
do	.. 9	26.3	20.1	1.45	11.5
do	.. 10	28.9	22.3	1.27	12.9
do	.. 11	29.5	22.6	1.30	12.7
<i>Inferior variety</i>					
Black and bits	.. 12	30.0	25.5	1.62	11.3
do	.. 13	32.6	26.9	1.65	11.3

The figures show that all the samples give more or less the same value for water extract and alkalinity although in samples 12 and 13, which were derived from a shrivelled and dis-

coloured variety of seeds classified as black and bits, the alkalinity and caffeine content are distinctly higher than those for samples 7 to 11 prepared from *C. arabica*, which are much superior in flavour and quality. It is noteworthy that in samples 1 to 6 derived from *C. robusta* a high caffeine figure is associated with a low fat content (Petrol Extract). This fact does not appear to have been recorded so far. The high caffeine content of some genuine coffees observed by Venkatachalam and Sundaram² could probably be accounted for by the advent of more *C. robusta* on the market. It is stated that of the total acreage under coffee in South India, the area under *C. robusta* has increased from 10 per cent. in 1937 to 25 per cent. in 1947.

The fat content of *C. robusta* falls in the range of 7 to 9 per cent. Canada and some Australian States which have defined "coffee" to include *C. robusta* as in Madras State, have fixed for coffee powder a minimum fat content of 10 per cent. This figure appears to be too high and 7 per cent. would be a suitable minimum.

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GLUCOFRUCTOSAN FROM *POLIAN-
THES TUBEROSA* LINN. AND GARLIC
(*ALLIUM SATIVUM* LINN.)

BELVAL¹ isolated a polyfructosan from *Polianthes tuberosa* with the use of baryta. We have found that it can be done with greater facility by step-wise precipitation with ethanol.

The specific rotation (α)^{25°} of (i) polyfructosan (thrice precipitated from ethanol) was -39.0° , (ii) its acetate (in CHCl_3), -22.3° , (iii) the deacetylated material, -39.6° and (iv), of (iii) after mild acid hydrolysis, -84.4° (for acetylation and deacetylation see methods under reference²). The polyfructosan obtained after deacetylation was chromatographically pure, giving a single spot (Zero Rf; pure yellow with benzidine trichloroacetic acid), but after mild acid hydrolysis contained, besides fructose (major fraction), also glucose (presence shown by chromatography and estimated to be 5 per cent. by Klein and Acree's method³). Thus, experimental proof has been provided for the first time that glucose is an integral part

of this polyfructosan molecule, though Belval¹ was the first to make this assumption on the basis of observed optical rotation of the hydrolysate of the polyfructosan.

Also, we have now found that the polyfructosan from garlic⁴ contains combined glucose (chromatographic evidence); in the light of this evidence, the molecular configuration proposed by Kihara⁵ for the polyfructosan from garlic, with fructose as the only structural unit, would need revision.

Our thanks are due to Dr. V. Subrahmanyam for his kind interest in the work.

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LOXOSTEGE MESSALIS WALKER—A NEW CATERPILLAR PEST OF RAGI IN MYSORE STATE

AN unusual outbreak of *Loxostege messalis* Walker (Lepidoptera-Pyralidae) occurred in Kolar District in 1952, when, specially during August-September, it covered over a thousand acres of ragi (*Eleusine coracana*), which is a very important staple food crop in Mysore State. Again in 1953 the insect re-appeared in great numbers in some of the areas (approximately over 250 acres) in which the pest had occurred during the previous year. This is the first record of this insect occurring in a pest form, and infesting ragi.

Hampson² recorded *L. messalis* from West Africa, North-West Himalayas, Punjab, Karachi, Poona, Ceylon and Australia. Fletcher¹ stated that it occurred throughout the plains of India and Ceylon, and that in Pusa the larvae fed on the tender top leaves of maize plant. In the present case, the caterpillars were feeding extensively on ragi in Mulbagal, Srinivasapur and Chickballapur Taluks of Kolar District.

Except for the passing reference by Fletcher (1920), there seems to be no information concerning the life-history and habits of this species in the Indian literature. Eggs have not been observed. The young larvae are about 1/6", pale green and with a dark head.

The full-grown larvae are about 3/4" long, pale green to brownish in colour with dark longitudinal lines on the dorsal and lateral sides, with the head dark, small and slightly pointed. The caterpillars attack the ragi crop in swarms. Each caterpillar spins a web across the upper side of the leaf, under the cover of which it feeds on the green tissues and skeletonises the leaf-blades. The injury is done so quickly, often within a couple of days, that the farmers imagine the pest to have migrated from the adjoining fields during the night. No general migrations of the larvae have, however, been observed. The larval stage lasts about 2 weeks. Pupation takes place in a white silken cocoon either in the webbings made by the larvae on the plants or underground, the latter being the more common. The pupae are slender, brown, about 1/2" in length; pupal stage occupies 10-12 days. Hampson² has described the adult moth.

Two Ichneumonid parasites, *Mesochorus* sp. and *Cremastis* sp. were obtained from the pupae of *L. messalis*. Effective control of the pest was obtained by dusting the infested ragi fields with 5 per cent. BHC.

We are grateful to Sri. B. Krishnamurti, Government Entomologist, for facilities, and to the Director, Commonwealth Institute of Entomology, London, for identification of the insect species.

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THE PRESENT SYSTEMATIC POSITION OF THE SUGARCANE LEAF-HOPPER *PYRILLA PERPUSILLA* WALKER

IN the literature on the insect pests of sugarcane in India, three species are recorded to be of common occurrence, viz., *Pyrilla perpusilla* Walker, *P. aberrans* Kirby and *P. pusana* Distant. Each of the three species is apparently found in abundance at a particular season of the year as mentioned by Misra⁶ and Pruthi.⁷ With reference to the controversy in regard to the number of species of *Pyrilla* found in India, the present work was undertaken to obtain a full and clear picture of the morphology of the adult males and females of *Pyrilla*

of the three so-called species, which have been recorded from various parts of India.

For the sake of convenience, we grouped the different types of *Pyrilla* under three separate categories or groups met with during different seasons of the year. The criterion for grouping them was on the basis of colour, number and size of spots and presence or absence of the apical cross-bands on the tegmina. In the first form, the apical margin of the tegmina is dark with prominent spots which also bears a pair of transverse bands formed by the fusion of contiguous spots. This form is in abundance in the fields during the rainy season, i.e., between July to September and part of October. The second form of *Pyrilla* is the one with pale tegmina, but the apical margin is only very slightly darker than the rest of the tegmina and the spots are as prominent as in the previous case, but marked by the absence of the transverse bands. The spots are distributed in both the cases towards 1/3rd of the apical margin. The second group of *Pyrilla* is found during the period September to February of the following year. The third type is with light-coloured tegmina which are somewhat pale yellow, homogeneous in colour and the spots are minute and distributed up to near about the middle of the forewing. This form is present from January to June. Thus the three forms described above have been classified according to their seasonal occurrence: (1) Monsoon-Autumn form—*Pyrilla aberrans* Kirby,³ (2) Autumn-Winter form—*Pyrilla pusana* Distant,¹ (3) Winter-spring and summer form of *P. perpusilla* Walker¹¹⁻¹² respectively.

The study of ♂ genitalia of the three species as made by Pruthi⁷ and Quadri and Aziz^{8,9} and their separation based on the structures of the anal-tube, sēdeagus and parameres do not appear to yield sufficiently definite data for their differentiation, since the characters for distinguishing the three Indian forms appear to be insignificant.

A study of the external morphology of the supplemented also by inter-breeding experiments three forms especially of the ♂ genitalia, was under laboratory conditions in order to obtain confirmatory results. The present authors noted that in nature as well as under laboratory conditions, the rainy season form recognized up till now as *P. aberrans* paired freely with the form occurring during winter months known as *P. pusana*. Moreover, forms occurring during winter were found to breed successfully with the summer form, viz., *P. perpusilla*.

Thus both morphological and breeding experiments conducted in the laboratory are in conformity with the observations made in the field. All these facts lead the authors to conclude that there is only one typical species in existence, viz., *P. perpusilla*, the other two so-called species being only seasonal colour variations or phases. In conclusion, we would consider the systematic position of the three Indian forms existent in India to be as follows: (1) Winter-spring-summer form—*Pyrilla perpusilla* Walker, 1851; (2) Monsoon-autumn form—*P. perpusilla* var. *aberrans* Kirby, 1891; (3) Autumn-winter form—*P. perpusilla* var. *pusana* Distant, 1914.

The authors wish to record their thanks to Dr. E. S. Narayanan for providing the necessary facilities for the work.

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CHROMOSOME STUDIES ON *RHIPICEPHALUS SANGUINEUS* *LATERILLE* AND *HYALOMMA* *AEGYPTIUM* NEWMANN (ACARINA: IXODIDAE)

THERE seems to be a paucity of information regarding the chromosomes of the family Ixodidae except for a publication by Tuzet and Milot,¹ who worked on the spermiogenesis of *Rhipicephalus bursa* and *Hyalomma aegyptium* and casually stated the chromosome number to be twelve in the primary spermatocyte metaphase of these two genera. Some work has, however, been done on the families Gamasidae and Argasidae, where the males seem to be diploid^{2,3}; while in the family Tarsonemidae there is a haplo-diploid system

of sex-determining mechanism as reported by Cooper.^{4,5} With a view to investigate the sex-determining mechanism in the family Ixodidae the present work was undertaken.

Testes from males of *Rhipicephalus sanguineus* Laterille and *Hyalomma aegyptium* Newmann were fixed in medium Flemming both with and without acetic acid and then sectioned at 15 micra in thickness. Slides were stained with Iodine crystal violet.

Spermatogonial divisional stages have been rare in *Rhipicephalus* but not so in *Hyalomma*. The metaphase plates could not, therefore, be studied in the former. In *Hyalomma*, the prophase chromosomes are found to be quite well developed though they are very small in size. The metaphase plates show the chromosome number to be $2n = 21$ (Fig. 1). The autosomes

centric having the two arms unequal, and show no heteropycnosis.

Chromosome number in *Rhipicephalus* has been determined from the meiotic stages. It is seen that there are ten bivalents and one univalent, the latter representing the sex chromosome, at the various stages of meiosis. The X-chromosome in this genus is also the longest among all the chromosomes and is metacentric in form.

Compared with the size of the cell, the nuclei in both the genera are quite small. The earliest stages in the spermatogonium show two to four deeply stained bodies within the nucleus in the case of *Hyalomma* and one in the case of *Rhipicephalus*. Sharma⁶ has recognised these bodies as the nucleoli. At the earliest spermatocyte stage, the X-chromosome is found to be positively heteropycnotic and more or less spherical in form in *Rhipicephalus* and also in *Hyalomma*. The nuclei at this stage also show large number of deeply stained dots in both the genera. At diplotene stage one chiasma per bivalent has been observed in both. Occasionally two chiasmata are also observed in *Hyalomma*. Regarding the terminalization of chiasmata, it has been observed that in both *Hyalomma* and *Rhipicephalus*, there is a significant increase of terminal chiasmata from diplotene to diakinesis and from diakinesis to metaphase. In *Hyalomma*, the X-chromosome has sometimes been observed to be metacentric at diplotene stage in which case the two arms have been found to be unequal (Fig. 2). The two chromatids composing the X-chromosome have been found to be relationally coiled. At metaphase I, the chromosomes are arranged on the equatorial plate with the sex chromosome forming an accessory plate in both the genera (Fig. 3). The centrosome has been clearly observed in *Hyalomma* alone. This structure appears to be very small and spherical and is surrounded by a non-staining portion. During anaphase I, the sex chromosome has been found to be precocious in its movement only in *Hyalomma* (Fig. 4). Occasionally it has been to be lagging on the equatorial plate. In both the genera the first meiotic division being reductional for the X-chromosome (Fig. 5), two types of second division metaphase plates are obtained—one type with the X-chromosome (Figs. 6, 8) and the other without it (Fig. 7). The sex chromosome divides equationally at anaphase II stage in both the genera (Figs. 9, 10).

Thanks are due to Dr. P. Bhattacharya, for the facilities provided at the Division of Ani-



FIG. 1. Spermatogonial metaphase plate of *Hyalomma*, $\times 1,700$. FIG. 2. Diplotene stage of *Hyalomma*, $\times 1,270$. FIG. 3. Metaphase I stage of *Hyalomma*, $\times 1,270$. FIG. 4. Anaphase I stage of *Hyalomma*, $\times 1,270$. FIG. 5. Late anaphase I stage of *Hyalomma*, $\times 1,270$. FIG. 6. Metaphase II stage of *Hyalomma* with the X-chromosome, $\times 1,700$. FIG. 7. Metaphase II stage of *Rhipicephalus* without the X-chromosome, $\times 1,700$. FIG. 8. Metaphase II stage of *Rhipicephalus* with the X-chromosome, $\times 1,700$. FIG. 9. Anaphase II stage of *Rhipicephalus*, $\times 1,700$. FIG. 10. Anaphase II stage of *Hyalomma*, $\times 1,270$.

are all acrocentric while the sex chromosome, which is the largest in the complement, is meta-

mal Genetics, Indian Veterinary Research Institute, Izatnagar, and to Dr. S. P. Ray-Chaudhuri, Department of Zoology, University of Calcutta, for criticism.

Dept. of Zoology,
University of Delhi, Delhi-8,
March 16, 1954.

M. K. DUTT.

Grateful thanks are due to Mr. E. W. Mason and Dr. Brown of Commonwealth Mycological Institute, England, for their kind help in identification of the fungus.

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PLASMOPARA WILDEMANIANA
P. HENN. VAR. MACROSPORA ON A
NEW HOST RUNGIA PARVIFLORA NEES

The leaves of *Rungia parviflora* were found to be heavily infected by downy mildew soon after the rains in October 1953 at Bhagalpur. White cottony growths were found on the lower surface of the leaves, the corresponding upper surface exhibited light greenish to brown colouration. Irregular spots were formed on the leaves, gradually increasing in size, resulting in the withering of the leaves.

The mycelium of the fungus is endophytic, colourless and intercellular. Sporangioophores protrude from the stomata either singly or in fascicles. The sporangioophores are monopodially branched; the branches arise more or less at right angles to the main axis, the secondary branches are also at right angles, the terminal branches are apically obtuse. The sporangioophores are upright, 300-600 μ long and 7-12 μ thick with slight swollen base. Sporangia are hyaline, papillate, ovoid, 15-17 $\mu \times$ 11-14 μ . The number of sporangia were very few. Oospores were not seen.

The fungus under study exhibits close affinity in morphological characters to *Plasmopara wildeமானiana* P. Henn. var. *macrospora* Sawada¹ (Syn. *Pseudoplasmodium justiciæ* Sawada) on *Justicia procumbens* (Acanthaceæ) reported from Formosa and is therefore referred to the same species. The specimen has been deposited in Herb. C.M.I. (Herb. I. M.I. No. 54717).

It is evident from available literature, this is the first record of the fungus on *Rungia parviflora* which is a new host for the fungus.

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OCCURRENCE OF GROWTH RINGS
ON THE OTOLITHS OF THE INDIAN
WHITING, SILLAGO SIHAMA
(FORSKÅL)

STUDIES on otoliths and scales for determining the age and rate of growth of Indian fishes have been reported only during comparatively recent years. It is well known that the otoliths and scales of several species of fishes in the temperate region possess distinct annular rings. This character has been extensively used in determining the year class composition of fish populations. The fishery worker in the tropical region is at a disadvantage as the otoliths and scales of most tropical fishes do not indicate such clear markings. There are, however, a few instances where growth rings on otoliths and scales have been observed in tropical fishes.¹⁻⁴

During the course of investigations on the biology of the Indian whiting, *Sillago sihama* (Forsk.), very clear growth rings have been observed on the otoliths, and in most cases it is even possible to make out the complete rings with the naked eye. These otoliths, after cleaning, were evenly ground on carborundum with a drop of glycerine, dehydrated in various grades of alcohol, and finally cleared in xylol. The boundary lines between successive zones are well marked in many cases. The rings appear in dark translucent zones, concentric with the margin of the otolith, whereas the intervening zones appear white and opaque. False rings can be easily distinguished from the true rings by the characteristics given by Walford and Mosher⁵ for the Californian sardine, *Sardinops caerulea*.

The whiting catches landed along the coast of Rameswaram Island comprise individuals ranging in size from 2-29 cm., the commercial size being 16-23 cm. Observations made during the last 7 months indicate that this species of fish attains sexual maturity at a length of 13-14 cm., when they are perhaps one-year-old.

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Examination of this one-year-old fish shows a single ring on the otolith, while those of 16-20, 20-24 and 24-28 cm. size groups reveal distinctly two, three and four rings respectively. The photomicrographs of otoliths reproduced here



FIG. 1. Otolith of *Sillago sihama* (Forsk.) showing one growth ring. Body length of fish 14.2 cm., caught Oct. 10, 1953.

FIG. 2. Showing two growth rings. Body length of fish 19.5 cm., caught Oct. 28, 1953.

FIG. 3. Showing three growth rings. Body length of the fish 23.3 cm., caught Oct. 6, 1953.

were taken with reflected light and show clearly the first, the second and the third growth rings. There are instances where some of the otoliths failed to show distinct rings at all for reasons not yet clear or conclusive. In most of the cases only the first and the second rings are seen and only in a few examples were the third and fourth rings clearly marked. In this connection the scales of the fish were also examined and some of them show the formation of clear annuli, particularly in the advanced size groups, while in the earlier stages these annuli are not clear.

The results obtained from the length frequency distribution were checked with the growth zones on the otoliths and scales. A well represented mode in the 14-15 cm. size group coincides with the series of specimens which denote one ring on the otolith. The other modes are not clearly marked although there are indications of modes which will be clarified with further data.

It is difficult to explain the exact significance of the formation of rings on the scales and otoliths, but a more critical study is being made particularly in relation to the feeding habits of the fish. It is probable that reduced feeding and the maturation of gonads occurring simultaneously may perhaps play a part in the formation of the growth checks found in the otoliths and scales. Details of the work will be published elsewhere.

My thanks are due to Dr. N. K. Panikkar for his guidance and encouragement.

Central Marine Fisheries N. RADHAKRISHNAN,
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DACTYLISPA ALBOPILOSA GESTRO: A NEW HISPID PEST OF JOWAR (ANDROPOGON SORGHUM) IN INDIA

DURING the months of August-September 1953, the Jowar plants in the plot of land adjoining the Institute were found to be heavily infested with a type of Hispid beetle, which was later on identified as *Dactylispa albopilosa* Gestro belonging to the superfamily Phytophaga, family Chrysomelidae.

The species *albopilosa* was first described by Gestro in 1888, from Thagata in Burma (there was no mention of the host plant) and has not, so far, been recorded as a crop pest. This species is being recorded for the first time as a pest of Jowar in India.

The genus *Dactylispa* comprises a large number of species having a wide range of distribution in Ceylon, Sumatra, Dutch East Indies and Tanganyika. They have established themselves as serious pests of various commercially important crops like cinchona, kapok, coffee and maize.

Insects are oblong and about 5 mm. in length, yellowish brown in colour (Fig. 1). Prothorax quadrate, anterior cylindrical region raised into a pair of spines. On either of the lateral sides of the prothorax, there are three spines. The first and the second appendiculate on a common stalk, the second being the longer; the third and outermost spine is free, small and pointed. The apices of all the spines are black. Elytra punctate and striate. Along the scutellar edge of the elytra are four spines, the first and the last of which are longer. On each side, the elytral margin bears fourteen spines, while each elytral surface bears twelve. All the spines, except the minute ones (which are yellowish brown), are black with also a small area round their base.

The adults, as well as the grubs feed on the green matter of leaves. The adults are external feeders and feed by scraping the leaf, while the leaf-mining grubs feed voraciously on the



FIG. 1. *Dactylispa albopilosa*—adult

tissues between the two epidermal layers of the leaf and finally pupate there. The affected portions of the leaf are thus rendered membranous and transparent making the grubs and the pupae visible.

The loss of chlorophyll prevents the leaves from carrying out their normal functions, affecting thereby the nutrition and growth of the plant.

The pest can easily be controlled by clipping off the affected leaves and burning them. BHC 5% dust, DDT 5% dust and 50% wettable DDT may be used for the control of the adults.

The authors' thanks are due to the Commonwealth Institute of Entomology for kindly identifying the insect and to Dr. S. N. Banerjee for encouragement and help.

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OCCURRENCE OF *OIDIOPSIS TAURICA* (LEV.) SALMON ON A NEW HOST, *RICINUS COMMUNIS* L.

Oidiopsis taurica (Lev.) Salmon is a cosmopolitan fungus found on a wide range of hosts, many of which are of minor or no economic importance, except the commonly grown vegetables *Cyamopsis psoraloides* and *Dolichos lablab*. A new variety of *O. taurica* var.

macrospora was described by Uppal, Kamat and Patel¹ on the latter.

The author found recently a solitary plant of castor (*Ricinus communis*) in Poona showing a species of *Oidiopsis*. The leaves showed yellowish chlorotic patches on the upper surface, and an overgrowth of the greyish fungus consisting of conidiophores and conidia on the lower.

The fungus is typically endophytic with button-shaped haustoria in the mesophyll cells and sends out tufts of simple conidiophores through the stomata, mainly on the lower side, bearing characteristic barrel-shaped or conical conidia. The conidia measure from 50.5 to 70.2 $\mu \times 15$ –19.5 μ , and their shapes were found to tally closely with those typical for *Oidiopsis taurica* from *C. psoraloides* (47–71 $\mu \times 10$ –20 μ). This fungus is, therefore, determined as *Oidiopsis taurica* (Lev.) Salmon.

The author is grateful to Prof. M. N. Kamat for guidance and to Dr. S. P. Agharkar for facilities offered.

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ALIMENTARY CANAL AND ASSOCIATED STRUCTURES OF THE JASSIDAE (HOMOPTERA)

At present our knowledge of the digestive system of the Jassidae is confined to *Cicadula sexnotata* (Dobrosky),¹ *Idiocerus clypealis* and *I. niveosparvus* (Quadri),² and *Typhlocyba ulmi* (Willis).³ Quadri denies the presence of 'filter-chamber' in jassids while Dobrosky reports its presence. In *Typhlocyba ulmi*, Willis does not find a true chamber enclosing the apposed extremities of the midgut yet he refers to this part of the gut as the 'filter-chamber region'. The writer extended the study of digestive system to the following jassids:

Subfamily Hecalinæ: *Hecalus lefroyi* Dist., *Parabolocratrus porrectus* Walk.; Subfamily Aphrodinæ: *Leofa mysorensis* Dist., *Chiasmus alata* Pruthi, *Gurawa vexillum* Dist.; Subfamily Tettigellinæ: *Tettigella spectra* (Sign.); Subfamily Idiocerinae: *Idiocerus clypealis* (Leth.); Tribe Euscelini: *Nephotettix apicalis* Motsch.; Tribe Balcluthini: *Eugnathodius indica* Pruthi; Tribe Platymetopiini: *Paternus vertica* Pruthi;

Subfamily Typhlocybinae: *Empoasca kerri* Pruthi, *E. devastans* Dist., *Empoascanara prima* Dist. and *Typhlocyba gemmata* Dist.

The alimentary canal commences at a short, muscular pharynx which leads into a narrower oesophagus. The latter extends upto the meta-thorax to open into the midgut which lies in the abdomen disposed in the form of 'U' with its two limbs variously coiled. Three distinct regions can be distinguished in the midgut: an anterior sac-like first ventriculus, a tubular second ventriculus and, a tubular third ventriculus which differs from the preceding region in the presence of numerous minute globules in its lumen. The two extremities of the midgut lie apposed to each other. The third ventriculus is followed by a narrower intestine which proceeds backward to open into a short pear-shaped rectum. Four malpighian tubules open into the midgut a short distance in front of the pyloric valve. Of these, two open separately while the other two open by a short common duct. Each malpighian tubule presents three zones: a proximal narrow, tubular region which is translucent; a middle wide, whitish opaque region, and a distal short, narrower region.

The alimentary canal and the malpighian tubules present together three different conditions in different jassids examined. (i) In the Typhlocybinae the two apposed extremities of the midgut are not enclosed by any sheath of tissue so that the 'filter-chamber' is absent. The wall of the midgut includes a layer of longitudinal muscle fibres. All the malpighian tubules are joined together at their distal ends so that their lumina are confluent. (ii) In the Balcluthini the two apposed extremities of the midgut are enclosed in a common chamber, the 'filter-chamber'. The wall of the midgut is devoid of the longitudinal muscle fibres. The distal ends of the malpighian tubules are joined together, as in the Typhlocybinae. (iii) In the rest of the jassids there is present a distinct 'filter-chamber' whose size differs in different species. The wall of the midgut is devoid of the longitudinal muscle fibres, as in the previous group. Unlike the first two conditions, the malpighian tubules in this case do not join together but they re-associate separately with the rectum and project into its lumen.

The salivary glands also present two conditions in this family. In the Hecalini each principal gland consists of two regions: a small rosette-shaped cluster of acini and an elongate cluster of acini situated beneath the crown along its lateral margins. The two salivary ducts open separately into the salivary syringe.

On the other hand, in the rest of the jassids the principal gland comprises only a small rosette-shaped cluster of acini and the two salivary ducts join together before opening into the syringe.

The taxonomic significance of these characters will be discussed separately.

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EFFECT OF EXCESSIVE NITROGENOUS MANURING ON THE LODGING AND YIELDS OF WHEAT

INDIAN soils are mainly deficient in nitrogen which should be applied in optimum amount to obtain high yields. The application of nitrogen in inadequate amounts may impede the exploitation of the variety, while the same in excess may not only be ineffective in affecting the crop growth but may lead to some deleterious effects such as lodging and may reduce the final yields.¹⁻⁴ The present paper summarises the response of wheat (Pb. 591) to increasing levels of nitrogen (0, 15, 30, 45, 60, 75, 100 and 105 lb. nitrogen per acre) applied in the form of ammonium sulphate with and without basal dressing of FYM (20 lb. nitrogen per acre) together with the adverse effect of excessive nitrogenous manuring as a result of the lodging of the crop. The experiment was conducted during the year 1950-51 at the B. R. College Experimental Farm, Bichpuri (Agra). The soil was light loam in texture and of average fertility.

The experiment was conducted in single split plot design with four replications taking basal and no basal dressing as the main treatment. FYM was applied one month before and ammonium sulphate one day before the sowing of wheat by broadcasting on the soil surface and mixing by ploughing.

The grain and bhusa yields obtained under different treatments are given in Table I.

The grain yield increased with increasing levels of nitrogen upto 60 lb. N per acre and decreased thereafter under higher levels than this while the bhusa yield increased with increasing levels throughout. The application of nitrogen at each level increased both the grain and bhusa yields significantly over control.

TABLE I
Grain and bhusa yields (md./acre) under
different levels of nitrogen

Levels of nitrogen	Grain yield	Bhusa yield
0	14.31	28.57
15	17.17	37.33
30	19.14	41.16
45	22.51	48.15
60	23.49	51.36
75	22.39	54.24
100	22.22	54.59
105	22.04	55.56
C.D. @ 5%	2.61	6.23
C.D. @ 1%	3.51	8.34

The crop lodged a fortnight after the completion of ear emergence under 75, 100 and 105 lb. nitrogen per acre. The observations were taken on the extent of lodging and its effect on the bhusa and grain yields under the respective levels of nitrogen. Under the levels of nitrogen that induced lodging, the expected yields of both grain and bhusa that might have been obtained, if there had been no lodging, have also been calculated.

TABLE II
Extent of lodging and its effects on acre yields

Treatments	Percentage of total area lodged	Reduction in acre yields in percentages		Expected yield (Md./acre)	
		Grain yield	Bhusa yield	Grain yield	Bhusa yield
75 lb. N/acre	27.12	46.36	33.19	25.50	62.24
100 " "	31.12	51.29	32.95	25.80	64.24
105 " "	40.00	50.00	34.42	27.43	66.32
Basal dressing of F.Y.M.	31.20				
No Basal dressing	34.30				

The percentage of area lodged increased with increasing levels of nitrogen, unlike inorganic nitrogen the application of basal dressing reduced the lodging. On an average the lodging reduced the grain and bhusa yield by 49.21 per cent. and 33.52 per cent. respectively. The expected yields under different levels of nitrogen indicate that the yields of both grain and bhusa would have increased with increasing levels of nitrogen even upto 105 lb. nitrogen per acre, had there been no lodging at all.

Thus it is clear from the results that excessive nitrogenous manuring is responsible for an appreciable reduction in both the grain and bhusa yields by causing the wheat crop to lodge. Therefore, under the conditions tried in the experiment the dose of nitrogen beyond 60 lb. per acre should not be applied to wheat crop as it means a double disadvantage, i.e., a loss of valuable fertilizer on the one hand and the reduction in the yield on the other.

The author is highly thankful to Dr. N. K. Anant Rao under whose guidance the experiment was conducted.

Dept. of Agronomy,
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INSDOC LIST OF CURRENT SCIENTIFIC LITERATURE

THE INSDOC List, No. 1, Vol. 1, of which has already appeared, is published semi-monthly by the Indian National Scientific Documentation Centre, New Delhi-12, with the aim of rapidly informing scientific workers in India and neighbouring countries of the latest papers published in the leading scientific and technical journals of the world. The INSDOC List also includes information on scientific reports and other non-journal material received by the NPL-INSDOC Library, as well as titles of

translations available from INSDOC, or about which information has been received from the British Commonwealth Scientific Office and other documentation centres.

The entries are arranged in broad subject groups in accordance with the colon classification; but Universal Decimal Classification Numbers are also given. The arrangement of subjects appears on the inside of the front cover. The subscription rate of the INSDOC List is Rs. 10 per year.

REVIEWS

Analysis of Deformation, Vol. I. By Keith Swainger. (Chapman & Hall), 1954. Pp. xix + 285. Price 63 sh.

Analysis of deformation, both elastic and plastic, has fascinated many mathematicians, engineers and physicists. Small deformations give rise to elegant mathematical theories like that of elasticity and slow viscous flow. The theory of finite deformation has been used to explain a number of experimental results like axial stresses produced in a cylinder subjected to finite twist. It has been the subject of a number of recent investigations. In 1935 a paper by B. R. Seth (*Phil. Trans. Roy. Soc.*, 234, 231-264) marked the beginning of a series of papers on this subject by F. D. Murnaghan, R. S. Rivlin, D. Panov, P. M. Riz, N. Zvolinsky, C. Truesdell and others. In it the idea was stressed that for technical applications finite components of strain should be referred to the deformed framework. The keypoint in the present book is also the same. The author defines the true normal strain as $e = (l - l_0)/l$, l and l_0 being the stretched and unstretched lengths. On the basis of a linear stress-strain relation it gives $T = E(l - l_0)/l = E[1 - (1 + s)^{-1}]$, s being the ordinary stretch. The tension stretch curve is now not a straight line.

When referred to spatially fixed axes in the deformed framework the strain tensor has second degree terms in the gradient of the deformation and is given by

$$\epsilon_{ij} = (u_{i,j} + u_{j,i}) - u_{k,i}u_{k,j},$$

comma denoting covariant differentiation. Using the method of dyadics the author wants to make out that the second degree terms are not necessary if the deformation is referred to locally convected axes. In such a case the equations become linear if the stress-strain tensor relation is assumed to be linear. For plastic problems this is bound to give good results. This point the author has made out in a number of papers. For elastic problems his ideas have been subjected to criticism by C. Truesdell, R. S. Rivlin and others. The author in turn criticizes Rivlin's postulate that a rotation of a line element through 180° changes the sign of the scalar stretch ratio. He also points out that Rivlin's confusion of scalar and vector effects is responsible for his criticism of Seth's method.

In mathematical language the author's exposition refers to the fact that in a deformed body any further small strains referred to the strained framework are tensorial in character, and hence no non-linear terms may be taken in the finite strain components. From the applicational point of view the spatially fixed frame is important, and it is not clear how the locally convected axes will help to solve technical problems. The author has reserved applications for Vol. II of his work and all concerned will await its publication.

Vector and dyadic methods are used throughout the book. It has nine chapters dealing with displacement, stress, strain, stress-strain relations, thermal effects, yield and elastic, visco-elastic, elasto-plastic isotropic substances. There are three appendices on vectors, scalars and potential theory. A list of references is given but there are no references to Russian work. Even Novozhilov's "Foundations of the non-linear theory of elasticity" is not listed. A glossary is a valuable addition to the book which is very well got up. On p. 175, the initials of Murnaghan should be changed from F. T. to F. D. The semi-colon used for partial differentiation in the book should be understood to imply covariant differentiation if the formulae are to be used in the curvilinear orthogonal system. All interested in the development of continuum mechanics will find the book excellent reading.

B. R. SETH.

Tables of Barometric Pressures at Varying Temperatures. By J. D. W. Ball. (Constable & Co.), 1953. Pp. 23. Price 5 sh.

The Tables contain equivalents of barometric pressure measured in millibars or inches of mercury, expressed in terms of kilogrammes per square centimetre, pounds per square inch and pounds per square foot. Conversions of kilogrammes per square centimetre into bars at standard gravity and Greenwich gravity are also given. A limited range of pressure from 720-800 mm. of mercury at temperatures from $0-40^\circ\text{C}$. is covered. The Tables would be useful to technical workers interested in this restricted range of pressures and temperatures.

In pages 10-16, inches of mercury are expressed as 28.5, 28.55, 29.5, 29.65, etc., the

second decimal being omitted when it is zero. The retention of zero in the second decimal place would have helped in making the values unambiguous. The get-up is good and the publication is neat and handy. P. KOTESWARAN.

Characteristics and Applications of Resistance Strain Gages (*Proceedings of Symposium held November 8 and 9, 1951.*) (NBS Circular 528.) (Order from Govt. Printing Office, Washington 25, D.C.) Pp. 140. Figs. 143. Tables 15. Buckram Bound. Price \$1.50.

The papers presented at this symposium represent some of the latest results, both experimental and theoretical, in the study of resistance strain gages by many leading institutions in the United States and abroad.

Papers presented at the symposium covered these applications and also reported new work in progress on strain gages consisting of a conducting coating applied by an evaporation technique, on special temperature compensated gages, on gages for strain measurements well beyond the elastic range, and on the application of strain gages to the determination of dynamic properties of materials and to the measurement of very large static forces. Eleven papers are reported in the volume along with transcriptions of the discussions that followed.

Abnormal Oscillations in Electric Circuits Containing Capacitance. By Niels H. Knudsen. (Number 69 of Transactions of the Royal Institute of Technology, Stockholm, Sweden), 1953. Price Kr. 12.

The monograph is in three parts. The first part gives a resumé of the history of the phenomenon and the work done so far by different workers in this field. The author discusses the oscillations under two groups, dealt with in Parts II and III. (a) Ferro-magnetically generated oscillations covering subharmonics, jump phenomena at supply or dynamic frequency and ultraharmonics; and (b) Machine-generated oscillations covering self-excitation of synchronous and asynchronous machines. The phenomena of oscillations in some cases may be of a parasitic nature, in which cases these are regarded as disturbances and the main interest is concentrated upon the question of how to avoid them. In some cases, it is also of interest to know the amplitude the oscillations will attain because of abnormal circuit conditions.

In Part II, Ferromagnetic resonance oscillations are described. The selection of a proper

analytical expression for the magnetization curve of the inductor to enable one to carry out the analysis of the ferro-resonance phenomena and equivalent circuits to represent in performance the behaviour of ideal and non-ideal inductors are discussed in detail. Three sections in this part are devoted to resonance at subharmonic, supply and higher harmonic frequencies. In each case, the theory of the method of calculation is developed and experimental results obtained earlier by other workers are discussed in the light of the theory developed.

Part III deals with the problem of self-excitation of induction and synchronous machines. In each case the general theory is developed and the principal question, which concerns the character of natural oscillations, is dealt with by examining the roots of the characteristic equation belonging to the system. The applications of the theory to a number of practical cases of different kinds are discussed. Finally, brief mention is made of theoretical and experimental investigations made in Sweden.

An exhaustive bibliography of available literature in the subject is given. The monograph will be of special interest and help to those concerned with the problem of power system operation with reference to disturbances met with due to abnormal oscillations.

C. S. GHOSH.

(i) **A New Theory of Sheet Movements and Continental Expansion.** (ii) **The Gondwana Formations of India and the Nature of Gondwanaland.** (*Memoirs 1 and 2*). By K. P. Rode. Department of Geology, Rajputana University.

In the first of these memoirs, covering about 30 pages, Dr. Rode has ventured to tackle one of the fundamental and controversial problems in geology, viz., the origin and distribution of continents and oceans—a problem which has engaged the attention of eminent geologists for more than a hundred years now, and in the study of which the name of Alfred Wegener, among recent workers, is so prominently associated. After noting certain observations from the tectonic and stratigraphic history of India and Africa, and interpreting them in his own way, Dr. Rode tries to derive support to his new theory of 'Sheet Movements and Continental Expansion'. The author admits that the theory, as now enunciated 'is still in its outline form, and needs much study to work out the details and its implications'; he nevertheless claims that it is essentially 'sound' and 'will

explain satisfactorily the numerous problems in geology which still defy solution'. It is, according to the author, 'a theory of universal application and seeks to develop a universal *modus operandi*, the exact nature of which is yet to be fully understood'.

In the second paper, Dr. Rode deals with the Gondwana formations of India and their comparison with similar formations in other Continents and on the basis of these studies a new idea of Gondwana land has been put forward. According to this, 'initially the various coal-bearing Gondwana formations in S. Hemisphere might all have been quite closely spaced, contiguous, or even partly overlapping, and that it was only in the post-Deccan Trap period that the various continental sheets bearing Gondwana sediments separated and spread out to their present positions', by a process of 'horizontal slicing of the Gondwana basin and movement of sheets either laterally or radially over long distances', as visualised by the author in his general theory of 'Sheet Movements and Continental Expansion' propounded in the first memoir.

It is hardly possible in the course of a short review like this to adjudge the merits of Dr. Rode's theory,—all the more so when it is presented in such a brief and summary manner. It is hoped that the author will soon come out, in justice to himself, with a fuller and more substantiated version of his theory, which will help us to understand and follow his arguments more clearly, and thus enable fruitful discussion.

Spot Tests, Vol. I. (Inorganic Applications.)

By Fritz Feigl. Translated by Ralph E. Oesper. (Elsevier Publishing Co.), 1954. Pp. xii + 518. Price 45 sh.

This book presents in a very readable manner the merits and the applicability of the spot test technique in qualitative as well as quantitative inorganic analysis.

The first two chapters expound the beginnings and development of spot tests and also give a clear account of the equipment and procedures employed for their application.

The third chapter deals with tests for metals and this is subdivided into four parts dealing respectively with (a) basic and acid sulphide groups, (b) ammonium sulphide group, (c) ammonium carbonate group, and (d) alkali metals and ammonia and its derivatives. The fourth chapter describes the tests for anions, while the fifth is concerned with general and specific tests for free metals, alloys and also

free non-metals. Chapter six presents some tested schemes for the systematic analysis of mixtures by spot reactions while Chapter seven gives some important applications of spot reactions in tests of purity, examination of technically important materials and studies of minerals. The concluding chapter is devoted to a summary in tabular form of the limits of identification attainable in spot tests.

The characteristics of the several tests for the various ions such as limit of identification and dilution limit are given in each case. The tests which have been thoroughly tested by the author are described in detail. The procedure for the test as well as the preparation of test and reagent solutions are clearly indicated. It is therefore possible to select the most appropriate reagent and procedure for the substance to be tested. The book includes several tests developed by the author which have not yet been published elsewhere.

This book by Prof. Feigl, who has made the most outstanding contributions to the development of spot tests, is a very noteworthy publication and will be of much assistance to all engaged in work of a chemical nature. The printing and get-up are excellent.

K. R. K.

Chromatography. (A Review of Principles and Applications.) By E. Lederer and M. Lederer. (Elsevier Publishing Co.), 1953. Pp. xviii + 460. Price 60 sh.

Chromatography as an analytical tool has been used quite extensively during the last decade for the separation and purification of organic and inorganic substances. Several monographs have already been published on the subject and extensive reviews have also been written on one or more aspects of chromatography.

The book under review has, however, certain unique features which makes it a welcome addition to the existing publications. The authors have in this volume discussed under three broad divisions of adsorption chromatography, ion exchange chromatography and partition chromatography the principles and the different kinds of equipment employed, and then proceed to give in very great detail, the separation by chromatographic technique of organic and inorganic substances. It is perhaps in the division of chromatography of inorganic substances, especially in the chapter on inorganic paper chromatography, that the book excels, and appears to be the most authoritative and exhaustive treatment of that particular subject. Further, the book contains valuable informa-

tion about all types of equipment used in different kinds of chromatography. Extensive references are included in the text and references appearing in the literature after July 1952 have been given chapterwise towards the end of the book.

It is obvious that considerations of brevity have induced the authors to write thus on p. 118: 'Examples of successful purification of hydroxylated and unsaturated lactones may be found in 651, 652, 653, 1394, 1935' and on p. 151: 'For the isolation of optically active mepacrine by direct chromatography of urine, see (643)'. Also it is felt that 'et al.' and 'coll.' have been used without adopting uniform terminology for such common expressions. But these are just minor points only, which will no doubt be attended to in a future edition.

The volume is amply illustrated with excellent diagrams and photographs, including a few which are coloured reproductions and the tabulated data giving characteristics like Rf values under well defined conditions for many organic and inorganic substances. The book should therefore prove to be extremely useful to all those who are interested in acquainting themselves with the different techniques and applications of either adsorption or ion exchange or paper chromatography.

P. S. SARMA.

Chemistry of Carbon Compounds, Vol. IIB. (Alicyclic Compounds). Edited by E. H. Rodd. (Elsevier Publishing Co.), 1953. Pp. 489-1092. Price £ 5-5-0.

Volume IIA of the series described systematically the simpler type of compounds of alicyclic nature and was reviewed earlier in this Journal. Volume IIB deals with substances of increasing complexity found largely in plant and animal kingdoms.

The first half of the book (Ch. 12-16) concerns the chemistry of terpenoids and is written by D. H. R. Barton with certain portions by S. H. Harper. The second half (Ch. 17, 18 and 19) relating to the steroids is under the authorship of C. W. Shoppee and Eileen Shoppee. These authors have been intimately connected with the chemistry of these groups and hence the treatment is authoritative and modern. Most of the subject-matter of this volume is of current interest. Actually, the systematic study of sesquiterpenes began from 1920 and those of di- and tri-terpenes later than 1930. It is well known that the chemistry of steroids assumed great importance only during the past 20 years. The elucidation of

structure and later the synthetic work constitute one of the most brilliant chemical achievements of the second half of this century. Many of these substances belong to physiologically active groups. Not only are they of complex structure but involve stereochemical problems of great interest. In Chapter 13 a clear and concise treatment of the Wagner-Meerwein and Nametkin Rearrangements is given. Under steroids are included such important groups as sterols and bile acids, sex-hormones and adrenocortical hormones and finally cardiotonic glycosides and aglycones, toad poisons, saponins and sapogenins. Though in keeping with the general plan of the series the account has been kept concise, it is extremely clear. There is no doubt that this volume provides very useful reading and reference material for all students of organic chemistry in regard to the highly important sections dealt with.

T. R. SESHADRI.

Detergency Evaluation and Testing. (Interscience Publishers Manual 4). By J. C. Harris. (Interscience Publishers, Inc.). Pp. x + 210. Price \$ 3.75.

"Detergent", which a few decades back, was a word in the dictionary of pedants to designate soap, today encompasses a much wider range of commercial chemicals, while newer and newer cleansing compositions are continuously invading the market. The larger their number and variety, the greater is the problem of choice of suitable composition for any specific use. Just at present when the question of suitable evaluation procedures for correct choice of detergents is of paramount importance, Mr. Harris must be congratulated for bringing out a collective compendium on the subject of "Evaluation and Testing of Detergents".

The book has been divided into 9 chapters including the introduction and deals with topics like screening tests, washing procedures for fibres like cotton, wool and others and tests for the same, hard surface cleaning, etc. Chapter VIII deals with radio isotopic tracer method of testing which is a highly interesting and potentially powerful method though still in its initial stage. The author has presented a few select surface-active agents with their trade names, their percent activity, physical or commercial form, and chemical constitution in Table I. Each chapter is supplemented with an adequate bibliography giving references mostly to recent publications.

The author has taken particular care to do full justice to the experimental details, and the book contains 25 plates including diagrams and photos of equipment used in testing procedures, so that it can be confidently be recommended as a reference work to those who deal with detergents.

The book is written in a lucid language, and has been got up neatly and nicely on glazed paper.
P. B. JANARDHANAN.

A Colored Atlas of Some Vertebrates from Ceylon, Vol. II. (*Tetrapod reptilia*.) By P. E. P. Deraniyagala. (Ceylon National Museums Publication: The Ceylon Government Press), 1953. Pp. 101. Plates 35. Text-figures 44.

The second volume of the *Atlas* fully maintains the high standard which the author had set for himself in the first volume dealing with an account of the "Fishes of Ceylon" (*Curr. Sci.*, 1952, 21, 147). The author, besides giving a systematic account of 9 testudines (5 marine), 2 crocodiles, 23 geckes, 12 agamids, 1 chamæleon, 25 skinks, 1 lacertid and 2 varanids, has illustrated the various species by a large number of drawings, coloured and black and white prepared by himself which make the identification of the animals easy even for an amateur naturalist. The value of the work is further enhanced by the fact that ecological and biological data concerning the species are also given, mostly based on the field and laboratory observations of the author himself. The reviewer is particularly happy to find in a work of this nature notes on zoogeography, climatic fluctuations, species fluctuations and economics. Though these subjects are treated very briefly, it is clearly shown that a modern systematist does not confine his attention to the preserved specimens in museum but takes into consideration the animals and the environments in which they live.

Under zoogeography, a critical examination of the writer's Saptura hypothesis would have been very appropriate. However, on p. 52, the author makes an important statement when he says, "The *Agamidæ* apparently entered Ceylon in three separate waves". These waves of migration must have come from Peninsular India. According to Ripley (*Evolution*, 1949, 3, 150-59), birds also came to Peninsular India from south-east Asia in three separate waves. Silas [*Proc. Nat. Inst. Sci. India*, 1952, 18 (5), 423-48], has also shown that some of the freshwater fishes entered Peninsular India from the north-east in a series of waves corresponding to the Pleistocene Glacial

Periods. It would thus appear that a proper synthesis of the facts concerning animal distribution in South India and Ceylon could now be a very fruitful line of investigation.

The reviewer is not satisfied with the maps of Ceylon. It could have been easily made much larger so that the various ecological associations and letterings could be shown more legibly. The delimitation of the boundaries of the various provinces, so frequently referred to in the text, would have enhanced the usefulness of the map.

The author, the Ceylon National Museums and the Government of Ceylon are to be congratulated on the publication of such a high class work which is sure to stimulate thought and guide further researches into the interesting and specialised insular fauna of Ceylon. The *Atlas* is equally useful for the students of Indian fauna, particularly for those interested in the animal life of Peninsular India. The get-up of the volume is good and the Ceylon Government Press is to be thanked for it.

S. L. HORA.

Timber, Its Structure and Properties. Third Revised Edition. By H. E. Desch. (Macmillan & Co., Ltd.), 1953. Pp. 1224 + 350. Price 25 sh.

The third edition of Desch's book on timber is most welcome. It was first published in 1938. The second edition was done in 1947. In the present edition he has added considerably large material to bring it up-to-date and to make it more useful to readers. "Classification of Trees" and "Nomenclature of Timbers" have been re-written with a view to make the subjects clear. The nomenclature of timbers is a difficult subject and still remains to be solved. The author has, however, clearly indicated the present position. Chapters in Part III have been re-arranged. Again, the chapter on "Defects in Timber" has been dealt with separately and now includes natural defects and seasoning degradation. "The Eradication of Fungal and Insect Attack" forms a separate chapter. Under "Grading of Timber", the author has first dealt with the general principles involved in grading. He then gives some information on the trade practice in the countries of Baltic Sea, of America and of the Commonwealth. Finally, he deals with "Wood as an Engineering Material" wherein "Timber Connectors" and "Adhesives" are discussed.

The present edition includes some additional plates with nice photomicrographs. It must be said here that the students using this book may

not find all the information they want, because from the fundamental point of view this book does not cover a very wide field. In fact it will serve better for the practical men than for the student of wood anatomy. Under the heading "Storage Tissue", wood parenchyma cells have been dealt with. The diagrammatic classification given here may serve for elementary students of wood anatomy, but as far as the reviewer knows there is no foundation for such a classification.

On the whole, the book is a valuable addition to our literature on timber technology. The author should be congratulated for producing such a book. K. A. CHOWDHURY.

Books Received

Fish Culture in Indonesia. Edited by A. E. Hofstede, R. O. Ardiwinata and F. Botke. (IPFC, Special Publications), 1953. Pp. xii + 129.

Organised Industries of India—Cement. By S. L. Sharma. (The Universal Publishers, Ltd., Hazratganj, Lucknow), 1954. Pp. 70. Price Re. 1.

Grahasarani Planetary Tables, Vol. I. (Tables for Mercury). By Harihar P. Bhatt. (Gujarat Vidya Sabha, Ahmedabad), 1953. Pp. viii + 20 + 18. Price Rs. 2.

The Insulation of Electrical Equipment. Edited by W. Jackson. (Chapman & Hall), 1954. Pp. ix + 340. Price 42 sh.

Indo-Pacific Fisheries Council Proceedings. Section II. (IPFC Secretariat, FAO Regional Office, Bangkok), 1953. Pp. 103-276.

A Text-Book of Radar. Second Edition. Edited by E. G. Bowen. (Cambridge University Press), 1954. Pp. xiii + 617. Price 45 sh.

The Amplification and Distribution of Sound. Third Edition Revised. By A. E. Greenless. (Chapman & Hall), 1954. Pp. x + 300. Price 35 sh.

Characteristics and Applications of Resistance Strain Gages. (NBS Circular 528, Washington-25), 1954. Pp. 140. Price \$1.50.

Energy Transfer in Hot Gases. (National Bureau of Standards, Washington-25), 1954. Pp. 126. Price \$1.50.

The Properties of Tin. (Tin Research Institute Fraser Road, Greenford, Middlesex, England), March 1954.

Recent Advances in Chemotherapy, Vol. III. By F. C. O. Valentine and R. A. Shooter. (J. & A. Churchill, Ltd., London, W.1), 1954. Pp. viii + 292. Price 27 sh. 6 d.

Tables of Lagrangian Coefficients of Sexagesimal Interpolation. (NBS Applied Mathematics Series 35.) (Office of the Scientific Publications, Washington-25, D.C.). Pp. 157. Price \$2.00.

Organic Peroxides. By A. V. Tobolsky and R. B. Mesrobian. (Interscience Publishers, Inc.), 1954. Pp. x + 197. Price \$5.75.

Methods of Biochemical Analysis, Vol. I. Edited by David Glick. (Interscience Publishers, Inc.), 1954. Pp. x + 521. Price \$9.50.

Vapor Pressure of Organic Compounds. By T. Earl Jordan. (Interscience Publishers, Inc.), 1954. Pp. ix + 266. Price \$14.50.

Feigl Spot Tests, Vol. II. (Organic Applications.) By Fritz Feigl. (Elsevier Publishing Co.), 1954. Pp. xv + 436. Price 37 sh. 6 d.

PROFESSOR M. N. SAHA*

THE Meghnad Saha Sixtieth Birthday Committee deserve to be congratulated for the well-authenticated volume they have brought out on the life, work and philosophy of the eminent scientist. After a couple of chapters devoted to his early childhood and student days, the next fifteen chapters give a very readable account of Professor Saha's contribution as a scientist of international fame, as well as a teacher and guru, to those who came for study and guidance under him. The last eight chapters serve to emphasise the disinterested public worker, which has often led him into the political field. The volume contains a good number of ex-

cellently produced photographs. Besides messages of appreciation received from distinguished scientists all over the world on the occasion of his sixtieth birthday, there are also two articles on Prof. Saha from Dr. J. C. Ghosh and Prof. N. R. Sen, which have a special value as coming from old school fellows of his. A complete list of original scientific papers and special articles published by Professor Saha, is also included.

* *Professor Meghnad Saha—His Life, Work and Philosophy.* Published by Meghnad Saha Sixtieth Birthday Committee, 1954, pp. 175, Price Rs. 5.

SCIENCE NOTES AND NEWS

Breaking the Dormancy in Seeds of Turmeric (*Curcuma longa*)

Sri. B. Misro, Central Rice Research Institute, Cuttack-4, writes as follows:

Turmeric seeds were soaked for 10 minutes in 50 per cent. H_2SO_4 in a beaker, the acid being stirred constantly. The seeds were separated by filtration and thoroughly washed with distilled water to remove any traces of the acid and transferred to a petri dish containing moist blotting paper. The material was washed daily with distilled water to remove any fungus growth. After 10 days the symptoms of germination appeared in a proportion of the seeds and within a further lapse of 7 days, there was 90 per cent. germination.

Raptakos Medical Research Fellowships

The Raptakos Medical Research Board will consider applications for the award of Fellowships for research work on medical and allied subjects in recognised institutions situated in the Union of India. Applicants should have an M.B., B.S., or M.Sc. Degree or its equivalent, or not less than two years' experience in research work after B.Sc.

Applications in the prescribed form, which may be obtained from the Secretary and Treasurer, should be forwarded through the Guides under whom research work will be carried out and the Heads of the Institutions, and should reach the Secretary and Treasurer, Raptakos Medical Research Board, Dr. Annie Besant Road, Worli, Bombay-18, before September 1, 1954.

Wind Energy

The Fourth Session of the Advisory Committee on Arid Zone Research recommended that qualified experts be commissioned to prepare reports reviewing research carried out on energy sources and use as it pertains to arid and semi-arid regions. At the request of the UNESCO, the Secretariat of the World Meteorological Organization has undertaken to prepare the above reports. These reports are conceived as providing the background of facts and figures concerning wind regimes at heights appropriate for utilization of wind machines in the different arid areas mentioned above. Reports already submitted on the design of wind

machines and on the economic and practical aspects of utilizing wind energy in arid areas need to be related to the existence of suitable wind regimes and sites. The reports will constitute background material for the symposium on wind and solar energy which is being jointly organized by the Government of India and UNESCO and which will be held in the autumn of this year.

Cortisone and Aspirin

A Joint Committee of the Medical Research Council and the Nuffield Foundation, under the Chairmanship of Sir Henry Cohen, has reported that as a result of a trial of the treatment of patients in the early stages of rheumatoid arthritis, there appears to be surprisingly little to choose between cortisone and aspirin. The trial, reported in recent issue of the *British Medical Journal*, concerned 61 patients who had the disease not less than three months and not more than nine. But, it must be emphasized that the report deals with a limited type of patient with the disease in the early stages. For those with many years of incapacity, prolonged treatment with cortisone has been shown to be valuable. It will, however, be necessary in the light of the present results to review the whole position of aspirin in the treatment of the disease.

Zeitschrift für Physikalische Chemie, New Series

The first issues of the Frankfurt edition of *Zeitschrift für Physikalische Chemie, Neue Folge* are now available. The new series is in continuation of *Zeitschrift für Physikalische Chemie* (appearing since 1887), now being published by Akademische Verlagsgesellschaft, by arrangement with the original owners and in co-operation with Professors K. F. Bonhoeffer, Th. Förster, W. Jost, Georg-Maria Schwab, former editors of the previous series.

Every effort will be made to restore this periodical to its previous international reputation. An International Advisory Board of leading physico-chemists is now being formed.

During 1954, two volumes of *Zeitschrift für Physikalische Chemie, Neue Folge* (New Series), will be published. Orders for and inquiries about these volumes, each priced at \$8.35, should be addressed to Akademische

Verlagsgesellschaft, m.b.H., Holbeinstrasse 25-27, Frankfurt am Main, Germany.

Annals of Library Science

We welcome the opening number of the *Annals of Library Science* which has been recently issued under the distinguished editorship of Dr. S. R. Ranganathan. The contents of the number are: Depth classification, Abstract classification and Demonstration, by S. R. Ranganathan, Critique of UDC and Library Science, by Faqir Chand, Dialectics of UDC, by K. A. Issac, Glossary of Cataloguing Terms, by K. D. Puranic, Library Development Plan for Delhi State, by S. R. Ranganathan and Training for Library Service in Sweden, by G. Ottervik and Moehlenbrock. Further particulars can be had from: The Editor, C 6, Maurice Nagar, University of Delhi, Delhi-8.

Vegetation Types of India

A symposium on the vegetation types of India will be held by the Indian Botanical Society on December 31, 1954, and the following days at Baroda. Workers in the field are requested to send their manuscripts together with brief abstracts so as to reach Shri R. Misra, Convener, Department of Botany, University of Saugar, Saugar, M.P., before September 1, 1954. The contributed papers and the proceedings of the symposium will be published at an early date. It is expected to cover the following types of vegetation of the dif-

ferent regions of the country:—forests, grasslands, aquatic vegetation, mangrove, desert vegetation, vegetation of other habitats such as sand dunes, silted banks, eroded and barren areas, etc. The ecological accounts will be given under the following headings—climate, geology and soils, biotic features, floristic composition, succession, climax, etc.

Norwegian Technical Aid to India

The Norwegian Parliament has voted another £ 500,000 to finance the Norwegian technical aid project in India. Altogether, Parliament has now voted £ 1,500,000 for this project and another £ 200,000 has been raised by a national collection throughout Norway.

Indian Dairy Science Association—Officers for 1954

President: Sardar Bahadur Sir Datar Singh;
Vice-Presidents: Dr. K. C. Sen, Sri. P. N. Nanda;
Joint Secretaries: Sri. M. K. Sastri, Dr. S. C. Ray; **Treasurer:** Dr. Noshir N. Dastur.

CORRECTION

Vol. 23, No. 3, p. 94: Note on "Use of Growth Substances in the Induction of Parthenocarp in *Lycopersicum esculentum* and *Capsicum annuum*": In column 2, line 5, read 1 p.p.m. for 10 p.p.m.

Vol. 23, No. 3, p. 105: Review of "An Introduction to Electronics for Physiological Workers": In column 1, read Macmillan & Co., Ltd. for Macwilliam & Co., Ltd.

FORTHCOMING INTERNATIONAL SCIENTIFIC AND TECHNICAL CONFERENCES

Date	Subject of Conference	Further particulars from	Location
July 25-August 8	World Power Conference—Section Meeting (Special Energy Problems of the Tropical and Sub-Tropical Countries)	Dr. Ciro Roman Farina, Rua Visconde de Inhauma 134-15° Rio de Janeiro, Brazil	Rio de Janeiro
August 23-28	World Congress on the Philosophy of Science	Professor Gonseth, Polytechnicum, Zurich, Switzerland	Zurich
August 23-Sept. 4	International Scientific Radio Union—11th General Assembly	M. Ing. E. Herbays, 42 Rue des Minimes, Brussels	Amsterdam
August 25-Sept. 1	Symposium on Analytical Chemistry	Dr. J. W. Robinson, Post Office Engineering Dept., Birmingham 5	Birmingham
August 30-Sept. 9	International Mathematical Union—2nd General Assembly	Prof. E. Bompiani, Instituto Matematico, Citta Universitaria, Rome	The Hague and Amsterdam
September 1-8	International Cytological Congress	Prof. P. G. Gaillard, Histologisch Laboratorium, Rijksuniversiteit, Leiden, Netherlands	Leiden, Netherlands
September 11-19	International Congress of Industrial Chemistry	M. Guilmot, 32 rue Joseph II, Bruxelles, Belgium	Brussels